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ADDRESS OF THE PRESIDENT TO THE PHYSIOLOGICAL SECTION OF THE BRITISH ASSOCIATION.

WE who have come from the little island on the other side of the great waters to take part in this important gathering of the British Association have of late been much exercised in retrospection. We have been looking back on the sixty years' reign of our beloved Sovereign, and dwelling on what has happened during her gracious rule. We have, perhaps, done little in calling to mind the wrongs, the mistakes and the failures of the Victorian era; but our minds and our mouths have been full of its achievements and its progress; and each of us, of himself or through another, has been busy in bringing back to the present the events of more than half a century of the past. It was while I, with others, was in this retrospective mood that the duty of preparing some few words to say to you to-day seemed suddenly to change from an impalpable cloud in the far distance to a heavy burden pressing directly on the back; and in choosing something to say I have succumbed to the dominant influence. Before putting pen to paper, however, I recovered sufficiently to resist the temptation to add one more to the many reviews which have appeared of the progress of physiology during the Victorian era. I also rejected the idea of doing that for which I find precedents in past presidential addresses—namely, of at-

tempting to tell what has been the history of the science to which a Section is devoted during the brief interval which has elapsed since the Section last met; to try and catch physiology, or any other science, as it rushes through the brief period of some twelve months seemed to me not unlike photographing the flying bullet without adequate apparatus; the result could only be either a blurred or a delusive image. But I bethought me that this is not the first, we hope it will not be the last, time that the British Association has met in the Western Hemisphere; and though the events of the thirteen years which have slipped by since the meeting at Montreal in 1884 might seem to furnish a very slender oat on which to pipe a presidential address, I have hoped that I might be led to sound upon it some few notes which might be listened to.

And indeed, though perhaps when we come to look into it closely almost every period would seem to have a value of its own, the past thirteen years do, in a certain sense, mark a break between the physiology of the past and that of the future. When the Association met at Montreal in 1884, Darwin, whose pregnant ideas have swayed physiology in the limited sense of that word, as well as that broader study of living beings which we sometimes call biology, as indeed they have every branch of natural knowledge, had been taken from us only some two years before, and there were still alive most of the men who did the great works of physiology of the middle and latter half of this century. The gifted Claude Bernard had passed away some years before, but his peers might have been present at Montreal. Bowman, whose classic works on muscle and kidney stand out as peaks in the physiological landscape of the past, models of researches finished and complete so far as the opportunities of the time would allow, fruitful beginnings and admirable guides for the labors of others. Brown-Sequard, who shares with Bernard the glory of having opened up the great modern path of the influence of the nervous system on vascular and thus on nutritional events, and who, if he made some mistakes, did many things which will last for all time. Brücke, whose clear judgment, as shown in his digestive and other work, gave permanent value to whatever he put forth. Du Bois-Reymond, who, if he labored in a narrow path, set a brilliant example of the way in which exact physical analysis may be applied to the phenomena of living beings, and in other ways had a powerful influence on the progress of physiology. Donders, whose mind seemed to have caught something of the better qualities of the physiological organ to which his professional life was devoted, and our knowledge of which he so largely extended, so sharply did he focus his mental eye on every physiological problem to which he turned—and these were many and varied. Helmholtz, whose great works on vision and hearing, to say nothing of his earlier distinctly physiological researches, make us feel that if physics gained much, physiology lost even more when the physiologist turned aside to more distinctly physical inquiries. Lastly, and not least, Ludwig, who by his own hands or through his pupils did so much to make physiology the exact science which it is to-day, but which it was not when he began his work. I say lastly, but I might add the name of one who, though barred by circumstances from contributing much directly to physiology by way of research, so used his powerful influence in many ways in aid of physiological interests as to have helped the science onward to no mean extent, at least among English-speaking people—I mean Huxley. All these might have met at Montreal. They have all left us now. Among the peers of the men I have mentioned whose chief labors were carried on in the forties, the fifties

and the sixties of the century, one prominent inquirer alone seems to be left, Albert von Kölliker, who in his old age is doing work of which even he in his youth might have been proud. The thirteen years which have swept the others away seem to mark a gulf between the physiological world of to-day and that of the time in which most of their work was done.

They are gone, but they have left behind their work and their names. May they of the future, as I believe we of the present are doing, take up their work and their example, doing work other than theirs but after their pattern, following in their steps.

In the thirteen years during which these have passed away physiology has not been idle. Indeed, the more we look into the period the more it seems to contain.

The study of physiology, as of other sciences, though it may be stimulated by difficulties (and physiology has the stimulus of a special form of opposition unknown to other sciences), expands under the sunshine of opportunity and aid. And it may be worth while to compare the opportunities for study of physiology in 1884 with those in 1897. At this meeting of the British Association I may fitly confine myself, I was going to say, to British matters; but I feel at this point, as others have felt, the want of a suitable nomenclature. We who are gathered here to-day have, with the exception of a few honored guests from the Eastern Hemisphere, one common bond, one common token of unity, and, so far as I know, one only; I am speaking now of outward tokens; down deeper in our nature there are, I trust, yet others. We all speak the English tongue. Some of us belong to what is called Great Britain and Ireland, others to that which is sometimes spoken of as Greater Britain. But there are others here who belong to neither; though English in tongue, they are in no sense British. To myself, to whom the being English in speech is a fact of far deeper moment than any political boundary, and who wish at the present moment to deal with the study of physiology among all those who speak the English tongue, there comes the great want of some word which will denote all such. I hope, indeed I think, that others feel the same want too. The term Anglo-Saxon is at once pedantic and incorrect, and yet there is none other; and, in the absence of such a better term, I shall be forgiven if I venture at times to use the seemingly narrow word English as really meaning something much broader than British in its very broadest sense.

Using English in this sense, I may, I think, venture to say that the thirteen years which separate 1884 from to-day have witnessed among English people a development of opportunities for physiological study such as no other like period has seen. It is not without significance that only a year or two previous to this period, in England proper, in little England, neither of the ancient Universities of Oxford and Cambridge, which, historically at least, represent the fullest academical aspirations of the nation, possessed a chair of physiology; the present professors, who are the first, were both appointed in 1883. Up to that time the science of physiology had not been deemed worthy, by either university, of a distinctive professorial mechanism. The act of these ancient institutions was only a manifestation of modern impulses, shared also by the metropolis and by the provinces at large. Whereas up to that time the posts for teaching physiology, by whatever name they were called, had been in most cases held by men whose intellectual loins were girded for other purposes than physiology, and who used the posts as stepping-stones for what they considered better things, since that time, as each post became vacant, it had almost invariably been filled by men wishing and pur-

posing at least to devote their whole energies to the science. Scotland, in many respects the forerunner of England in intellectual matters, had not so much need of change; but she, too, has moved in the same direction, as has also the sister island.

And if we turn to this Western Continent, we find in Canada and in the States the same notable enlargement of physiological opportunity, or even a still more notable one. If the English-speaking physiologist dots on the map each place on this Western Hemisphere which is an academic focus of his science, he may well be proud of the opportunities now afforded for the development of English physiology; and the greater part of this has come within the last thirteen years.

Professorial chairs or their analogues are, however, after all but a small part of the provision for the development of physiological science. The heart of physiology is the laboratory. It is this which sends the life-blood through the frame; and in respect to this, perhaps, more than to anything else, has the progress of the past thirteen years been striking. Doubtless, on both sides of the waters there were physiological laboratories, and good ones, in 1884; but how much have even these during that period been enlarged and improved, and how many new ones have been added? In how many places, even right up to about 1884, the professor or lecturer was fain to be content with mere lecture experiments and a simple course of histology, with perhaps a few chemical exercises for his students! Now each teacher, however modest his post, feels and says that the authorities under whom he works are bound to provide him with the means of leading his students along the only path by which the science can be truly entered upon, that by which each learner repeats for himself the fundamental observations on which the science is based.

But there is a still larger outcome from the professorial chair and the physiological laboratory than the training of the student; these are opportunities not for teaching only, but also for research. And perhaps in no respect has the development during the past thirteen years been so marked as in this. Never so clearly as during this period has it become recognized that each post for teaching is no less a post for learning, that among academic duties the making knowledge is as urgent as the distributing it, and that among professorial qualifications the gift of garnering in new truths is at least as needful as facility in the didactic exposition of old ones. Thirteen years has seen a great change in this matter, and the progress has been perhaps greater on this side of the water than on the other, so far as English-speaking people are concerned. We on the other side have witnessed with envy the establishment on this side of a university, physiology having in it an honored place, the keynote of which is the development of original research. It will, I venture to think, be considered a strong confirmation of my present theme that the Clark University at Worcester was founded only ten years ago.

And here, as an English-speaking person, may I be allowed to point out, not without pride, that these thirteen years of increased opportunity have been thirteen years of increased fruitfulness. In the history of our science, among the names of the great men who have made epochs, English names, from Harvey onwards, occupy no mean place; but the greatness of such great men is of no national birth; it comes as it lists, and is independent of time and of place. If we turn to the more everyday workers, whose continued labors more slowly build up the growing edifice and provide the needful nourishment for the greatness of which I have just spoken, we may, I will dare to say, affirm that the last thirteen

years has brought contributions to physiology, made known in the English tongue, which, whether we regard their quanity or their quality, significantly outdo the like contributions made in any foregoing period of the same length. Those contributions have been equally as numerous, equally as good on this side as on the other side of the waters. And here I trust I shall be pardoned if personal ties and affection lead me to throw in a personal word. May I not say that much which has been done on this side has been directly or indirectly the outcome of the energy and gifts of one whom I may fitly name on an occasion such as this, since, though he belonged to the other side, his physiological life was passed and his work was done on this side, one who has been taken from us since this Association last met, Henry Newell Martin?

Yes, during these thirteen years, if we put aside the loss of comrades, physiology has been prosperous with us and the outlook is bright; but, as every cloud has its silver lining, so shadow follows all sunshine, success brings danger, and something bitter rises up amid the sweet of prosperity. The development of which I have spoken is an outcome of the progressive activity of the age, and the dominant note of that activity is heard in the word 'commercial.' Noblemen and noblewomen open shop, and every one, low as well as high, presses forward towards large or quick profits. The very influences which have made devotion to scientific inquiry a possible means of livelihood, and so fostered scientific investigation, are creating a new danger. The path of the professor was in old times narrow and strait, and only the few who had a real call cared to tread it; nowadays there is some fear lest it becomes so broad and so easy as to tempt those who are in no way fitted for it. There is an increasing risk of men undertaking a research, not because a question is crying out to them to be answered, but in the hope that the publication of their results may win for them a lucrative post. There is, moreover, an even greater evil ahead. The man who lights on a new scientific method holds the key of a chamber in which much gold may be stored up; and strong is the temptation for him to keep the new knowledge to himself until he has filled his fill, while all the time his brother-inquirers are wandering about in the dark through lack of that which he possesses. Such a selfish withholding of new scientific truth is beginning to be not rare in some branches of knowledge. May it never come near us!

Now I will, with your permission, cease to sound the provincial note, and ask your attention for a few minutes while I attempt to dwell on what seem to me to be some of the salient features of the fruits of physiological activity, not among English-speaking people only, but among all folk, during the past thirteen years.

When we review the records of research and discovery over any lengthened period, we find that in every branch of the study progress is irregular, that it ebbs and flows. At one time a particular problem occupies much attention, the periodicals are full of memoirs about it, and many of the young bloods flash their maiden swords upon it. Then again for a while it seems to lie dormant and unheeded. But quite irrespective of this feature, which seems to belong to all lines of inquiry, we may recognize two kinds of progress. On the one hand, in such a period, in spite of the waves just mentioned, a steady advance continually goes on in researches which were begun and pushed forward in former periods, some of them being of very old date. On the other hand, new lines of investigation, starting with quite new ideas or rendered possible by the introduction of new methods, are or may be begun. Such nat-

urally attract great attention, and give a special character to the period.

In the past thirteen years we may recognize both these kinds of progress. Of the former kind I might take, as an example, the time-honored problems of the mechanics of the circulation. In spite of the labor which has been spent on these in times of old, something always remains to be done, and the last thirteen years have not been idle. The researches of Hürthle and Tigerstedt, of Roy and Adami, not to mention others, have left us wiser than we were before. So again, with the also old problems of muscular contraction, progress, if not exciting, has been real; we are some steps measurably nearer understanding what is the exact nature of the fundamental changes which bring about contraction and what are the relations of those changes to the structure of muscular fibre. In respect to another old problem, too, the beat of the heart, we have continued to creep nearer and nearer to the full light. Problems again, the method of attacking which is of more recent origin, such as the nature of secretion, and the allied problem of the nature of transudation, have engaged attention and brought about that stirring of the waters of controversy which, whatever be its effects in other departments of life, is never in science wholly a waste of time, if indeed it be a waste of time at all, since, in matters of science, the tribunal to which the combatants of both sides appeal is always sure to give a true judgment in the end. In the controversy thus arisen, the last word has perhaps not yet been said, but whether we tend at present to side with Heidenhain, who has continued into the past thirteen years the brilliant labors which were, perhaps, the distinguishing features of physiological progress in preceding periods, and who in his present sufferings carries with him, I am sure, the sympathies, if not the hopes, of all his brethren, or whether we are more inclined to join those who hold different views, we may all agree in saying that we have, in 1897, distinctly clearer ideas of why secretion gathers in an alveolus or lymph in a lymph space than we had in 1884.

I might multiply such examples of progress on more or less old lines until I wearied you; but I will try not to do so. I wish rather to dwell for a few minutes on some of what seems to be the salient new features of the period under review.

One such feature is, I venture to think, the development of what may perhaps be called the new physiological chemistry. We always are, and for a long time have been, learning something new about the chemical phenomena of living beings. During the years preceding those immediately recent, great progress, for which we have especially, perhaps, to thank Kühne, was made in our knowledge of the bodies which we speak of as proteids and their allies. But while admitting to the full the high value of all these researches, and the great light which they threw on many of the obscurer problems of the chemical changes of the body, such, for instance, as the digestive changes and the clotting of blood, it could not but be felt that their range was restricted and their value limited. Granting the extreme usefulness of being able to distinguish bodies though their solution or precipitation by means of this or that salt or acid, this did not seem to promise to throw much light on the all-important problem as to what was the connection between the chemical constitution of such bodies and their work in the economy of a living being. For it need not be argued that this is an all-important problem. To-day, as yesterday and in the days before, the mention of the word vitalism or its equivalent separates as a war-cry physiologists into two camps, one contending that all the phenomena of life can, and

the other that they cannot, be explained as the result of the action of chemico-physical forces. For myself, I have always felt that while such a controversy, like other controversies as I ventured to say just now, is useful as a stirring of the waters, through which much oxygen is brought home to many things and no little purification effected, the time for the final judgment on the question will not come until we shall more clearly understand than we do at present what we mean by physical and chemical, and may, perhaps, be put off until somewhere near the end of all things, when we shall know as fully as we ever shall what the forces to which we give these names can do and what they cannot. Meanwhile, the great thing is to push forward, so far as may be, the chemical analysis of the phenomena presented by living beings. Hitherto the physiological chemists, or the chemical physiologists as perhaps they ought rather to be called, have perhaps gone too much their own gait, and have seemed to be constructing too much a kind of chemistry of their own. But that, may I say, has in part been so because they did not receive from their distinctly chemical brethren the help of which they were in need. May I go so far as to say that to us physiologists these our brethren seemed to be lagging somewhat behind, at least along those lines of their science which directly told on our inquiries? That is, however, no longer the case. They are producing work and giving us ideas which we can carry straight into physiological problems. The remarkable work of Emil Fischer on sugars, one of the bright results of my period of thirteen years, may fully be regarded as opening up a new era in the physiology of the carbohydrates; opening up a new era because it has shown us the way how to invesigate physiological problems on purely and distinctively chemical lines. Not in the carbohydrates only, but in all directions our younger investigators are treating the old problems by the new chemical methods; the old physiological chemistry is passing away; nowhere, perhaps, is the outlook more promising than in this direction; and we may at any time receive the news that the stubborn old fortress of the proteids has succumbed to the new attack.

Another marked feature of the period has been the increasing attention given to the study of the lower forms of life, using their simpler structures and more diffuse phenomena to elucidate the more general properties of living matter. During the greater part of the present century physiologists have, as a rule, chosen as subjects of their observations almost exclusively the vertebrata; by far the larger part of the results obtained during this time have been gained by inquiries restricted to some half a dozen kinds of backboned animals; the frog and the myograph, the dog and the kymograph, have almost seemed the alpha and the omega of the science. This has been made a reproach by some, but, I cannot help thinking, unjustly. Physiology is, in its broad meaning, the unravelling of the potentialities of things in the conditions which we call living. In the higher animals the evolution by differentiation has brought these potentialities, so to speak, near the surface, or even laid them bare as actual properties capable of being grasped. In the lower animals they still lie deep buried in primeval sameness; and we may grope among them in vain unless we have a clue furnished by the study of the higher animal. This truth seems to have been early recognized during the progress of the science. In the old time, observers such as Spallanzani, with but a moderate amount of accumulated knowledge behind them, and a host of problems before them, with but few lines of inquiry as yet definitely laid down, were free to choose the subjects of their investigation where they pleased, and in the

wide field open to them prodded, so to speak, among all living things, indifferent whether they possessed a backbone or no. But it soon became obvious that the study of the special problems of the more highly organized creature was more fruitful, or at least more easily fruitful, than that of the general problems of the simpler forms; and hence it came about that inquiry, as it went on, grew more and more limited to the former. But an increasing knowledge of the laws of life as exemplified in the differentiated phenomena of the mammal is increasingly fitting us for a successful attack on the more general phenomena of the lowly creatures possessing little more than that molecular organization, if such a phrase be permitted, which alone supplies the conditions for the manifestation of vital activities. And, though it may be true that in all periods men have from time to time labored at this theme, I think that I am not wrong in saying that the last dozen years or so mark a distinct departure both as regards the number of researches directed to it, and also, what is of greater moment, as regards the definiteness and clearness of the results thereby obtained. One has only to look at the results recorded in the valuable treatises of Verworn and Biedermann, whether obtained by the authors themselves or by others, to feel great hope that in the immediately near future a notable advance will be made in our grasp of the nature of that varying collection of molecular conditions, potencies and changes, slimy hitherto to the intellectual no less than to the physical touch, which we are in the habit of denoting by the more or less magical word protoplasm. And, perhaps, one happy feature of such an advance will be one step in the way of that reintegration which men of science fondly hope may ultimately follow the differentiation of studies now so fierce and attended by many ills; in the problems of protoplasm the animal physiologist touches hands with the botanist, and both find that under different names they are striving towards the same end.

Closely allied to and, indeed, a part of the above line of inquiry is the study of the physiological attributes of the cell and of their connection with its intrinsic organization. This is a study which, during the last dozen years, has borne no mean fruits; but it is an old study, one which has been worked at from time to time, reviving again and again as new methods offered new opportunities. Moreover, it will probably come directly before us in our sectional work, and, therefore, I will say nothing more of it here.

Still another striking feature of the past dozen years has been the advance of our knowledge in regard to those events of the animal body which we have now learned to speak of as 'internal secretion.' This knowledge did not begin in this period. The first note was sounded long ago in the middle of the century, when Claude Bernard made known what he called 'the glycogenic function of the liver.' Men, too, were busy with the thyroid body and the suprarenal capsules long before the meeting of the British Association at Montreal. But it was since then, namely in 1889, that Minkowski published his discovery of the diabetic phenomena resulting from the total removal of the pancreas. That, I venture to think, was of momentous value, not only as a valuable discovery in itself, but especially, perhaps, in confirming and fixing our ideas as to internal secretion, and in encouraging further research.

Minkowski's investigation possessed this notable feature, that it was clear, sharp and decided, and, moreover, the chief factor, namely sugar, was subject to quantitative methods. The results of removing the thyroid body had been to a large extent general, often vague, and in some cases uncertain; so much so as to justify, to a cer-

tain extent, the doubts held by some as to the validity of the conclusion that the symptoms witnessed were really and simply due to the absence of the organ removed. The observer who removes the pancreas has to deal with a tangible and measurable result, the appearance of sugar in the urine. About this there can be no mistake, no uncertainty. And the confidence thus engendered in the conclusion that the pancreas, besides secreting the pancreatic juice, effects some notable change in the blood passing through it, spread to the analogous conclusions concerning the thyroid and the suprarenal, and moreover suggested further experimental inquiry. By those inquiries all previous doubts have been removed; it is not now a question whether or no the thyroid carries on a so-called internal secretion; the problem is reduced to finding out what it exactly does and how exactly it does it. Moreover, no one can at the present day suppose that this feature of internal secretion is confined to the thyroid, the suprarenal and the pancreas; it needs no spirit of prophecy to foretell that the coming years will add to physiological science a large and long chapter, the first marked distinctive verses of which belong to the dozen years which have just passed away.

The above three lines of advance are of themselves enough to justify a certain pride on the part of the physiologist as to the share which his science is taking in the forward movements of the time. And yet I venture to think that each and all of these is wholly overshadowed by researches of another kind, through which knowledge has made, during the past dozen years or so, a bound so momentous and so far-reaching that all other results gathered in during the time seem to shrink into relative insignificance.

It was a little before my period, in the year 1879, that Golgi published his modest note, 'Un nuovo processo di technica microscopia.'* That was the breaking out from the rocks of a little stream which has since swollen into a great flood. It is quite true that long before a new era in our knowledge of the central nervous system had been opened up by the works of Ferrier and of Fritch and Hitzig. Between 1870 and 1880 progress in this branch of physiology had been continued and rapid. Yet that progress had left much to be desired. On the one hand, the experimental inquiries, even when they were carried out with the safeguard of an adequate psychical analysis of the phenomena which presented themselves, and this was not always the case, sounded a very uncertain note, at least when they dealt with other than simply motor effects. They were, moreover, not unfrequently in discord with clinical experience. In general the conclusions which were arrived at through them, save such as were based on the production of easily recognized and often measurable movements, were regarded by many as conclusions of the kind which could not be ignored, which demanded respectful attention, and yet which failed to carry conviction. It seemed to be risking too much to trust too implicitly to the apparent teaching of the results arrived at; something appeared wanting to give these their full validity, to explain their full and certain meaning by showing their connection with what was known in other ways and by other methods. On the other hand, during nearly all this time, in spite of the valuable results acquired by the continually improving histological technique, by the degeneration method and by the developmental method, by the study of the periods of myelination, most of us, at all events, were sitting down, as our forefathers had done, before the intricate maze of encephalic structure, fascinated by its complexity, but

*_Rendiconti del reale Istituto Lombardo_, Vol. XII., p. 206.

wondering what it all meant. Even when we attempted to thread our way through the relatively simple tangle of the spinal cord, to expect that we should ever see our way so to unravel out the strands of fibres, here thick, there thin, now twisting and turning, and anon running straight, or so to set out in definite constellations the seeming milky way of star-like cells, so to do this as to make the conformation of the cord explain the performances of which it is capable, appeared to be something beyond our reach. And when we passed from the cord to those cerebral structures the even gross topography of which is the despair of the beginner in anatomical studies, the multiple maze of gray and white matter seemed to frame itself into the letters graven on the gateway of the city of Dis, and bid us leave all hope behind.

What a change has come upon us during the past dozen years, and how great is the hope of ultimate success which we have today. Into what at the meeting at Montreal seemed a cloudy masss, in which most things were indistinct and doubtful, and into which each man could read images of possible mechanisms according as his fancy led, the method of Golgi has fallen like a clarifying drop, and at the present moment we are watching with interest and delight how that vague cloud is beginning to clear up and develop into a sharp and definite picture, in which lines objectively distinct and saying one thing only reveal themselves more and more. This is not the place to enter into details, and I will content myself with pointing out as illustrative of my theme the progress which is being made in our knowledge of how we hear and how sounds effect us. A dozen years ago we possessed experimental and clinical evidence which led us to believe that auditory impulses sweeping up the auditory nerve became developed into auditory sensations through events taking place in the temporo-sphenoidal convolution, and we had some indications that as these passed upward through the lower and middle brain the striæ acusticæ and the lateral fillet had some part to play. Beyond this we knew but little. To-day we can with confidence construct a diagram which he who runs can read, showing how the impulses undergoing a relay in the tuberculum acusticum and accessory nucleus pass by the striæ acusticæ and trapezoid fibres to the superior olive and trapezoid nucleus, and onwards by the lateral fillet to the posterior corpus quadrageminum and to the cortex of the temporo-sphenoidal convolution. And if much, very much, yet remains to be done even in tracking out yet more exactly the path pursued by the impulses, while they are yet still undeveloped impulses, not as yet lit up with consciousness, and in understanding the functional meaning of relays and apparently alternate routes, to say nothing of the deeper problems of when and how the psychical element intervenes, we feel that we have in our hands the clue by means of which we may hope to trace out clearly the mechanisms by which, whether consciousness plays its part or no, sounds affect so profoundly and so diversely the movements of the body, and haply some time or other to tell, in a plain and exact way, the story of how we hear. I have thus referred to hearing because the problems connected with this seemed, thirteen years ago, so eminently obscure; it appeared so preeminently hard a task, that of tracing out the path of an ordinary impulse through the confused maze of fibre and cell presented by the lower and middlebrain. Of the mechanism of sight we seemed even then to have better knowledge, but how much more clearly do we, so to speak, see vision now? So also with all other sensations, even those most obscure ones of touch and pain; indeed, all over the nervous system light seems breaking in a most remarkable way.

This great and significant progress we owe, I venture to say, to Golgi, to the method introduced by him; and I for one cannot help being glad that this important contribution to science, as well as another contingent and most valuable one, the degeneration method of Marchi, should be among the many tokens that Italy, the mother of all sciences in times gone by, is now once more taking her right place in scientific no less than in political life. We owe, I say, this progress to Golgi in the sense that the method introduced by him was the beginning of the new researches. We owe, moreover, to Golgi not the mere technical introduction of the method, but something more. He himself pointed out the theoretical significance of the results which his method produced; and if in this he has been outstripped and even corrected by others, his original merit must not be allowed to be forgotten. Those others are many, in many lands. The first, perhaps, was Frithiof Nansen, whose brief but brilliant memoir makes us selfish physiologists regret that the icy charms of the North Pole so early froze in him the bubbling springs of histological research. Of the rest two names stand out conspicuous. If rejuvenescent Italy invented this method, another ancient country, whose fame, once brilliant in the past, like that of Italy, suffered in later times an eclipse, produced the man who, above all others, has showed us how to use it. At the meeting at Montreal a voice from Spain telling of things physiological would have seemed a voice crying out of the wilderness; to-day the name of Ramon-y-Cayal is in every physiologist's mouth. That is one name, but there is yet another. Years ago, when those of us who are now veterans and see signs that it is time for us to stand aside were spelling out the primer of histology, one name was always before us as that of a man who touched every tissue and touched each well. It is a consoling thought to some of the elder ones that histological research seems to be an antidote to senile decay. As the companion of the young Spaniard in the pregnant work on the histology of the central nervous system done in the eighties and the nineties of the century, must be named the name of the man who was brilliant in the fifties, Albert von Kölliker.

When I say that the progress of our knowledge of the central nervous system during the past thirteen years has been largely due to the application of the method of Golgi, I do not mean that it, alone and by itself, has done what has been done. That is not the way of science. Almost every thrust forward in science is a resultant of concurrent forces working along different lines; and in most cases at least significant progress comes when efforts from different quarters meet and join hands. And especially as regards methods it is true that their value and effect depend on their coming at their allotted times. As I said above, neither experimental investigation nor clinical observation nor histological inquiry by the then known methods had been idle before 1880. They had, moreover, borne even notable fruits, but one thing was lacking for their fuller fruition. The experimental and clinical results all postulated the existence of clear definite paths for impulses within the central nervous system, of paths moreover which, while clear and sharp, were manifold and, under certain conditions, alternate or even vicarious, and were so constructed that the impulses as they swept along them underwent from time to time—that is, at some place or other—transformations or at least changes in nature. But the methods of histological investigations available before that of Golgi, though they taught us much, failed to furnish such an analysis of the tangle of gray and white matter as would clearly indicate the paths required. This

the method of Golgi did, or rather is doing. Where gold failed silver has succeeded, and is succeeding. Thanks to the black tract which silver when handled in a certain way leaves behind it in the animal body, as indeed it does elsewhere, we can now trace out, within the central nervous system, the pathway afforded by the nerve cell and the nerve cell alone. We see its dendrites branching out in various directions, each alert to dance the molecular dance assigned to it at once by the more lasting conditions which we call structural, and the more passing ones which we call functional, so soon as some partner touch its hand. We see the body of the cell with its dominant nucleus ready to obey and yet to marshal and command the figure so started. We see the neuraxon prepared to carry that figure along itself, it may be to far-distant parts, it may be to near ones, or to divert it along collaterals, it may be many, or it may be few, or to spread out at once among numerous seemingly equipollent branches. And whether it prove ultimately true or no that the figure of the dancing molecules sweeps always onwards along the dendrites towards the nucleus, and always outwards away from the nucleus along the neuraxon, or whatever way in the end be shown to be the exact differences in nature and action between the dendrites and the neuraxon, this at least seems sure, that cell plays upon cell only by such a kind of contact as seems to afford an opportunity for change in the figure of the dance, that is to say, in the nature of the impulse, and that in at least the ordinary play it is the terminal of the neuraxon (either of the main core or a collateral) of one cell which touches with a vibrating touch the dendrite or the body of some other cell. We can thus, I say, by the almost magic use of a silver token—I say magic use, for he who for the first time is shown a Golgi preparation is amazed to learn that it is such a sprawling thing as he sees before him which teaches so much, and yet when he comes to use it acquires daily increased confidence in its worth—it is by the use of such a silver token that we have been able to unravel so much of the intricate tangle of the possible paths of nervous impulses. By themselves, the acquisition of a set of pictures of such black lines would be of little value. But, and this I venture to think is the important point, to a most remarkable extent, and with noteworthy rapidity, the histological results thus arrived at, aided by analogous results reached by the degeneration method, especially by the newer method of Marchi, have confirmed or at times extended and corrected the teachings of experimental investigation and clinical observation. It is this which gives strength to our present position; we are attacking our problems along two independent lines. On the one hand we are tracing out anatomical paths, and laying bare the joints of histological machinery; on the other hand, beginning with the phenomena, and analyzing the manifestations of disorder, whether of our own making or no, as well as of order, we are striving to delineate the machinery by help of its action. When the results of the two methods coincide, we may be confident that we are on the road of all truth; when they disagree, the very disagreement serves as the starting-point for fresh inquiries along the one line or the other.

Fruitful as have been the labors of the past dozen years, we may rightly consider them as but the earnest of that which is to come; and those of us who are far down on the slope of life may wistfully look forward to the next meeting of the Association on these Western shores, wondering what marvels will then be told.

Physiology, even in the narrower sense to which, by emphasis on the wavering barrier which parts the animal from the plant, it is restricted in this Section, deals

with many kinds of being, and with many things in each. But, somewhat as man, in one aspect a tiny fragment of the world, still more of the universe, in another aspect looms so great as to overshadow everything else, so the nervous system, seen from one point of view, is no more than a mere part of the whole organism, but, seen from another point of view, seems by its importance to swallow up all the rest. As man is apt to look upon all other things as mainly subserving his interests and purposes, so the physiologist, but with more justice, may regard all the rest of the body as mainly subserving the welfare of the nervous system; and, as man was created last, so our natural knowledge of the working of that nervous system has been the latest in its growth. But, if there be any truth in what I have urged today, we are witnessing a growth which promises to be as rapid as it has seemed to be delayed. Little spirit of prophecy is needed to foretell that in the not so distant future the teacher of physiology will hurry over the themes on which he now dwells so long, in order that he may have time to expound the most important of all the truths which he has to tell, those which have to do with the manifold workings of the brain.

And I will be here so bold as to dare to point out that this development of his science must, in the times to come, influence the attitude of the physiologist towards the world, and ought to influence the attitude of the world towards him. I imagine that if a plebiscite, limited even to instructed, I might almost say scientific, men, were taken at the present moment, it would be found that the most prevalent conception of physiology is that it is a something which is in some way an appendage to the art of medicine. That physiology is, and always must be, the basis of the science of healing, is so much a truism that I would not venture to repeat it here were it not that some of those enemies, alike to science and humanity, who are at times called anti-vivisectionists, and whose zeal often outruns, not only discretion, but even truth, have quite recently asserted that I think otherwise. Should such a hallucination ever threaten to possess me, I should only have to turn to the little we yet know of the physiology of the nervous system and remind myself how great a help the results of pure physiological curiosity—I repeat the words, pure physiological curiosity, for curiosity is the mother of science—have been, alike to the surgeon and the physician, in the treatment of those in some way most afflicting maladies, the diseases of the nervous system. No, physiology is, and always must be, the basis of the science of healing; but it is something more. When physiology is dealing with those parts of the body which we call muscular, vascular, glandular tissues and the like, rightly handled she points out the way not only to mend that which is hurt, to repair the damages of bad usage and disease, but so to train the growing tissues and to guide the grown ones as that the best use may be made of them for the purposes of life. She not only heals, she governs and educates. Nor does she do otherwise when she comes to deal with the nervous tissues. Nay, it is the very prerogative of these nervous tissues that their life is above that of all the other tissues, contingent on the environment and susceptible of education. If increasing knowledge gives us increasing power so to mould a muscular fibre that it shall play to the best the part which it has to play in life, the little knowledge we at present possess gives us at least much confidence in a coming far greater power over the nerve cell. This is not the place to plunge into the deep waters of the relation which the body bears to the mind; but this at least stares us in the face, that changes in

what we call the body bring about changes in what we call the mind. When we alter the one, we alter the other. If, as the whole past history of our science leads us to expect, in the coming years a clearer and deeper insight into the nature and condition of that molecular dance which is to us the material token of nervous action, and a fuller, exacter knowledge of the laws which govern the sweep of nervous impulses along fibre and cell, give us wider and directer command over the moulding of the growing nervous mechanism and the maintenance and regulation of the grown one, then assuredly physiology will take its place as a judge of appeal in questions not only of the body, but of the mind; it will raise its voice not in the hospital and consulting-room only, but also in the senate and the school.

One word more. We physiologists are sorely tempted towards self-righteousness, for we enjoy that blessedness which comes when men revile you and persecute you and say all manner of evil against you falsely. In the mother-country our hands are tied by an Act which was defined by one of the highest legal authorities as a 'penal' Act; and though with us, as with others, difficulties may have awakened activity, our science suffers from the action of the State. And some there are who would go still farther than the State has gone, though that is far, who would take from us even that which we have, and bid us make bricks wholly without straw. To go back is always a hard thing, and we in England can hardly look to any great betterment for at least many years to come. But unless what I have ventured to put before you to-day be a mocking phantasm, unworthy of this great Association and this great occasion, England in this respect at least offers an example to be shunned alike by her offspring and her fellows.

MICHAEL FOSTER.

CAMBRIDGE UNIVERSITY.

CHEMISTRY AT THE BRITISH ASSOCIATION.

THE work of the Chemical Section of the British Association was inaugurated with the address of its President, Professor Ramsay: 'An Undiscovered Gas.' Starting with a discussion of the history of the various periodic relationships which have been shown to exist among the elements, and of the definition of the properties of unknown members of several of the Groups prior to their isolation, the attempt was made to establish the probability of the existence, and to prophesy the characteristics of an element, as yet unknown, forming a 'triad' with helium and argon. Between fluorine and manganese lies chlorine; between oxygen and chromium, sulphur; between nitrogen and vanadium, phosphorus; between carbon and titanium, silicon, etc. The intermediate element possesses an atomic weight greater, on the average, by 16 units than that of the lightest member of the triad, and less by 20 units than that of the heaviest. Between the lightest and the heaviest, therefore, the difference in atomic weight is approximately 36 units, which is also the difference between the accepted atomic weights of helium (4) and argon (40). "There should, therefore, be an undiscovered element between helium and argon, with an atomic weight 16 units higher than that of helium, and 20 units lower than that of argon, namely 20. And if this unknown element, like helium and argon, should prove to consist of monatomic molecules, then its density should be half its atomic weight, 10. And, pushing the analogy still farther, it is to be expected that this element should be as indifferent to union with other elements as the two allied elements."

Professor Ramsay next reviewed his various efforts to obtain the third member of the helium-argon triad. The most promising method—that of systematic diffusion of the individual gases—failed to show the

presence of any second gas in purified argon; from what has been known as 'pure helium,' however, this process finally isolated a heavier gas which showed the spectroscopic characteristics of argon. No experimental evidence has so far been obtained for a gas with a density of 10.

The address concludes with a discussion of the probable position of argon in the Periodic System, the argument being along the same lines as that previously put forward by the author in his work, 'The Gases of the Atmosphere.' Attention is called to the fact that the differences of the atomic weights of elements following one another in any one Series are quite irregular, varying in the Lithium Series from 1.0 to 3.0, in the Sodium Series from 1.0 to 3.5, [etc. Again, in the Silver Series iodine undoubtedly follows tellurium, and yet all the recent determinations of the atomic weight of the latter element unite upon a figure almost a unit above that of iodine; just as density-determinations indicate an atomic weight for argon nearly one unit higher than that of potassium which *follows* it in the System. The author concludes that the relative weights of the atoms of elements, while indicating roughly their position in a perfect Periodic System, are not to be taken as the absolute criterion of their relative sequence. As it is not possible in this short review adequately to discuss this matter, the reader is referred to the author's own statement of the argument.*

In the course of the Meeting Professor Ramsay presented (1) a paper dealing with the process employed in the separation of gases of different densities by fractional diffusion, and (2)—for Mr. Morris Travers—a proof of the fact that the hydrogen evolved on heating minerals in a vacuum is due to the decomposition of water mechanically held and is not present in the form of any other compound. In a paper before the Physical Section he called attention to the great delicacy of refractivity-determinations as a means of deciding upon the purity of light gases.

The superiority of the oxalate method for the separation of thorium from the other elements with which it is usually associated was demonstrated by Professor Brauner, who also presented the results obtained in a redetermination of the atomic weight of the metal. Professor T. W. Richards reviewed his recent very important work upon the atomic weights of cobalt and nickel, explaining the methods of purification of the salts employed and the apparatus in which they were got ready for weighing. Professor Meslans gave an interesting exhibition of the properties of free fluorine prepared according to the method of Moissan, but in a vessel of copper, instead of platinum, and surrounded by a freezing-mixture of ice and solid carbon dioxide. A very brief paper by Professors Moissan and Dewar on some of the physical constants of liquid fluorine was read by Professor Meldola.

Other papers on inorganic chemistry were those of Mr. E. C. C. Baly, on the formation of a compound when mercury falls in a finely divided state through an atmosphere of oxygen, and which appears to contain the oxygen in the form of ozone; of Dr. C. A. Kohn, on the electrolytic determination of copper and iron in oysters, reminiscent of the recent 'oyster scare' in Great Britain; of Professor W. W. Andrews, on the great increase in the rapidity and accuracy of blowpipe determinations through the use of tablets of plaster of Paris instead of charcoal; of Professor Dunnington, on the occurrence of titanic oxide in soils; and of F. T. Shutt, on analyses of Canadian virgin soils.

In the field of organic chemisty the most interesting paper—perhaps the most striking communication presented at this meeting of

*SCIENCE, Oct. 1st, pp. 493–502.

the Association—was that of Professor Nef, on 'The Chemistry of Methylene,' only a portion of which, however, was read. The author, as a result of this and former work, claims among other things to have proved the existence of isomeric acetylenes, one of which is characterized by the presence of a bivalent carbon atom and should therefore be represented by the formula $= C : CH_2$. This substance and its derivatives are remarkable on account of their extraordinary instability, horrible odor and extremely poisonous properties—peculiarities shared in large measure by all compounds of bivalent carbon, among which the author includes the cyanides. By a continuation of the process of removing hydrogen, Professor Nef expects to isolate gaseous and liquid carbon, with molecular weights of 24 and 72, respectively! The publication of the full text of this remarkable paper will certainly be awaited with interest.

As the result of a careful research, Professor Freer brought forward further arguments in favor of the view advanced by Nef for the constitution of the aliphatic ketones and their metallic derivatives. Dr. Lehmann reported the production of benzene derivatives through the reduction of a 1:6 diketone formed by the condensation of benzil with two molecules of acetophenone. A paper on the 'Condensation-products of Aldehydes and Amides' was read by Dr. Kohn. A report of analyses of pre-carboniferous coals was presented by Professor W. H. Ellis.

Professor Roberts-Austen exhibited some photographs of the 'splash' produced by objects falling into molten metals, and intended to show the similarity of behavior in these and other liquids. Mr. Ramage explained a number of photographs of the spectra of minerals and metals, prepared by Professor Hartley and himself. Dr. W. L. Miller exhibited an apparatus designed to determine the vapor-tensions of liquid mixtures. Mr. W. L. T. Addison read a portion of an interesting paper on the formation of crystals. Short papers by Dr. Gladstone and Mr. Hibbert and by Dr. T. Waddell discussed the absorption of Röntgen rays by the light metals. The curious effects produced by certain metals upon a photographic plate when placed in contact with it, or even, in some cases, in its neighborhood, were discussed by Dr. W. J. Russell. In the mutual decomposition of hydrobromic and bromic acids, Professor James Walker finds an interesting case where the application of the theory of electrolytic dissociation furnishes a satisfactory explanation of the course taken by the reaction.

Two papers remain to be mentioned, that of Professor Andrews on 'Reform in the Teaching of Chemistry,' and that of Professor Meldola on 'The Rationale of Chemical Synthesis.' The latter was an attempt to find a common ground upon which the chemist and the physiologist could work, each along his own lines of research, and where, by united judicious effort, more rapid progress could be made into those mysterious regions now withholding from our eager quest so much of vast importance to mankind.

W. W. R.

GEOGRAPHY AT THE BRITISH ASSOCIATION.

The geographers of the United States and Canada have every reason to feel highly pleased with the reception given them at the Toronto meeting of the British Association. Every effort was made to have the visiting geographers feel that their hosts considered them, not guests, but fellow-workers. Nearly one-half of the general committee was composed of residents of North America, and one day was given over to papers concerning Canada and the United States. In all, nearly half of the papers presented were by Americans.

The National Geographic Society, of Washington, D. C., had made especial efforts to have America well represented, and much is due to its efforts. It is, however, to be regretted that there were so many papers of an historical character dealing with the geographic results of the several government bureaus of the United States and Canada, and so few papers on the one branch of geography in which America has done the most in the last few years, namely, Physiography. The absence of many of our best physiographers on official field duties partly accounts for the scarcity of such communications.

The meeting of the Section opened most auspiciously with a goodly attendance at the address of the President, Dr. J. Scott Keltie, Secretary of the Royal Geographical Society, and editor of the *Geographical Journal and Statesmen's Year Book*. Dr. Keltie's careful summary of the geographical results to date, and his outline of possible future work, has already been published in several places, and needs no further comment. The listening American was impressed with the heartfelt compliments that the author paid to the works of several Americans, and to the various United States government bureaus.

In the afternoon of the first day Sir George Robertson gave a very interesting and entertaining account of Kafiristan and the Kafirs, and his life among them. Mr. E. G. Ravenstein reported in brief the results of the Committee on the Climatology of Africa. The committee is continued with a grant of £10 from the Association. The two following papers were brief abstracts of recent investigations of the Physiography and Temperature of Nova Zembla and Spitzbergen.

The second day of the meeting was to have been devoted to educational papers, but there were not enough to fill the program. The day opened with a short paper by the writer on 'Scientific Geography for Schools,' a plea for the assistance of scientists in the planning and execution of geographical courses in schools for all grades. A brief summary was given by the President of the voluminous report of the Committee on Geographical Education, prepared by Mr. A. J. Herbertson. The Royal Geographical Society has within the last fourteen years accomplished a very great reform in geographical education, since the careful study of the conditions by Dr. Keltie brought attention to the matter. Other papers of the forenoon were by Lieutenant-Colonel Bailey, on 'Forestry in India.' Colonel Bailey gave a very interesting account of the present conditions of the forests and the methods of protection necessary, a paper that showed thorough familiarity with the subject at first hand. The indefatigable Recorder of the Section, Dr. Hugh R. Mill, who is also librarian of the Royal Geographical Society, presented a very thoughtful paper on the 'Classification of Geography,' based on the results of his labors in cataloguing. The last paper of the forenoon was by Mr. Vaughn Cornish, on the 'Distribution of Detritus by the Sea,' in which the author considered the ocean processes in much detail.

In the afternoon Professor John Milne, the seismologist, gave a very suggestive and interesting lecture on 'Certain Submarine Changes,' deduced from his study of earthquakes and the breaking of ocean cables. Professor Milne also gave a more popular and inclusive evening lecture before the whole Association, and other papers before the Geological Section, each of which presented many new thoughts of practical use to geologists and geographers. Mr. Ravenstein followed Professor Milne with a detailed account of the result of his studies concerning the Congo and the Cape of Good Hope from 1482 to 1488, and the first rounding of the Cape.

The third day was devoted to the geography of the United States and Canada, and the papers presented were mostly of a historical character, and included an account of the work of the various geographical institutions of the United States, by Marcus Baker; the Work of the United States Coast and Geodetic Survey, by Dr. T. C. Mendenhall; the Hydrography of the United States, by Mr. F. H. Newell; the Geographical Work of the United States Geological Survey, by Mr. C. D. Walcott; Geographical Work of the Canada Geological Survey, by Mr. C. J. White; the Work of the Canada Weather Bureau, by Mr. Stupart, and of the United States Weather Bureau, by Mr. Willis L. Moore.

Professor William M. Davis gave an account of the coastal plain of Maine. This paper epitomized the principles of the physiographic classification of land forms, and gave a careful account of the features of the coastal plain of Maine and its position in the classification, in spite of what appeared to be at first apparent anomalies. Mr. C. E. Lumsden entered a strong plea for the unification of time at sea, and showed the confusion arising from the present systems of time record employed by mariners. The paper of the day drawing the largest audience was that of the explorer and geographer, Dr. J. B. Tyrrell, who gave an interesting illustrated account of the Barren Lands of Canada. Some of the tales of game in this region of difficult traveling, though verified by the camera, were almost incredible.

The session of the fourth day, devoted to physical geography, opened with a large audience to greet the explorer and hunter, Mr. E. C. Selous, who gave a glowing account of the Economic Geography of Rhodesia, based on an intimate knowledge of about a quarter of a century. This paper added many data of value to those brought forth by the report of the Committee on Climatology of Africa, and was full of interest because of the present political condition of South Africa. Other papers of the morning were: 'A Journey in Tripoli,' by J. T. Myres; 'On the Direction of Lines of Structure in Eurasia,' by Prince Kropotkin; 'Potamology as a Branch of Geography,' by Professor A. Penck, and the 'Geographical Development of the Lower Mississippi,' by E. L. Corthell, concerning which it is impossible, for lack of space, to make separate note. Suffice it to say that these papers were among the most scientific of the physical geography papers, and were all of value. The afternoon session was again devoted to North America, with papers on 'Southeastern Alaska,' by Otto J. Klotz; 'The First Ascent of Mt. Lefroy and Mt. Aberdeen,' by Professor H. B. Dixon, and 'Mexico Felix and Mexico Deserta,' by O. H. Howarth. Recent exploration was well represented by the paper on Mt. Lefroy and Mt. Aberdeen, as these peaks had just been scaled for the first time within a few weeks of the meeting.

The last day was devoted to a geographical round up, and could not be classified. The principal paper, read by General A. W. Greely, was 'The Growth and Material Conditions of the United States,' prepared by Mr. Henry Gannett. Professor W. M. Davis spoke on the importance of geography as a university subject.

Though these papers were the only ones that were presented in the Section of Geography, they were not the only geographic papers before the Association; other papers pertaining to physical and anthropological geography were given in different Sections. When we consider the geographic papers *in toto*, we see that the meeting was memorable for the new geographic material presented. New ideas of political or physical geography were not all, however, that the visiting geographers carried away from Toronto. The contact with the

best geographers from abroad was of very great value, particularly to many of the younger men. On every hand good fellowship prevailed, and every one present felt a new impulse to work from the inspiration of the meeting. Many of the visitors took the trip to the western coast after the meeting, on which, according to reports, fully as great results geographically were obtained as at the meeting. Not only must Canada feel a new scientific movement of progress from the meeting, but the United States as well must join in the good to be obtained. The visitors from abroad all agreed that they had gained much from the trip more helpful than mere information. All the Americans trust that they have been able to give in return a part of what they have received, and that this international meeting may help the cause of geography on on both sides of the water.

RICHARD E. DODGE.

IS THE DENVER FORMATION LACUSTRINE OR FLUVIATILE?

THE usual interpretation of stratified deposits refers them to accumulation beneath water, either in the sea or in lakes. But many observers have recognized the ability of rivers to form stratified deposits more or less extensive; hence the mere occurrence of stratification might suggest fluviatile as well as lacustrine or marine origin; and some other sign than stratification would be needed to distinguish among these several conditions of deposition. When fossils are contained in the strata it is commonly easy to determine at least whether they were of salt or fresh water origin; but when without fossils, or when containing only fresh water or land fossils, it may be still a question whether the deposits were formed in lakes or rivers. It has been perhaps assumed that river deposits must be local, while lacustrine deposits may be widespread; but the immense fluviatile deposits of the Indo-Gangetic plain must suffice to free the products of aggrading rivers from narrow bounds. Blandford's account of the vast deposits of waste in long sloping plains at the base of mountain ranges in the interior basins of Persia, as well as the description of similar accumulations in our western country, shows that extensive stratified deposits may be formed in regions where even rivers are not a constant or conspicuous agency; and the believer in the competency of small processes to produce great results if time enough is allowed would find it difficult to set limits to the area or thickness of formation of such origin.

The distinction between true lacustrine sediments and true fluviatile sediments may be made in part by their composition and structure and in part by their fossils. River deposits are of variable sequence, coarse and fine, evenly or unevenly arranged, cross-bedded, ripple-marked and suncracked. Mid-lake deposits are of fine texture and even structure, becoming coarse and irregular only near their margin. A characteristic lacustrine fauna, enclosed in mid-lake silts, should be easily distinguished from the mixture of land and water fauna that might be preserved in coarser lake-border deposits or in the coarse and fine strata of normal river deposits. In the absence of a fauna, it might be difficult to distinguish lake-border deposits from river deposits; there might indeed be difficulty in separating lacustrine silts from the fine silts of river flood-plains, if fossils were wanting.

Gilbert's interpretation of some of the newer deposits on the Plains of Colorado near the Arkansas river as of fluviatile origin, and the adoption of his idea by the geologists of Kansas for the eastward extension of the same formations, has recently given practical application to the above generalities. Penck gives in his *Morphologie* a number of European examples of deposits ordinarily called lacustrine, but which

he regards as fluviatile. And on my return home from a sight of the Plains this summer, the receipt of Monograph XXVII., U. S. G. S., on the Geology of the Denver Basin, by Emmons, Cross and Eldridge, suggests a further extension of the discussion. It is particularly with regard to the Arapahoe and Denver formations, in Colorado, that the conditions of origin seem open to another interpretation than that given by these authors; for it is noticeable that a lacustrine origin seems to have been almost taken for granted, and that a fluviatile origin is not discussed.

The Arapahoe formation is thus introduced: "After an erosion of the Laramie beds * * *, a considerable fresh-water lake was formed and sedimentation again set in. What the exact area of this lake was it is not possible now to determine; * * * whether the lake was continuous along the mountain front or there were several small isolated basins it is as yet impossible to determine. * * * In it were deposited more than 600 to 800 feet of sediments. * * * Of these sediments the lower 50 to 200 feet were conglomerates, the upper 400 to 600 feet arenaceous clays. Vertebrate remains are found in both the conglomerates and the clays, more abundant and better preserved, however, in the latter." (P. 31, 32.)

The interval between the Arapahoe and Denver formations is thus described: "Between the deposition of the Arapahoe and Denver beds a considerable time-interval occurred, during which, as the record of the rocks shows, the Arapahoe lake was drained and the sediments deposited in its bottom were considerably eroded. The movement which caused the drainage of the lake was, as far as present indications go, rather local in its effects, and produced no important deformation of the beds already deposited. * * * This movement was succeeded, after a considerable lapse of time, by a depression sufficient to allow of the formation of a second lake in the Denver basin. * * * The nature of the depression which produced such lakes without admitting marine waters to any extent within the area affected is not readily conceivable, yet its effects are shown to have been widespread by the considerable thicknesses of fresh-water beds consisting largely of eruptive débris." (P. 32.)

The following description is given of the Denver deposits: "The beds deposited in the Denver Lake reached a thickness of over 1,400 feet along the flanks of the mountains, but were probably somewhat thinner toward the middle of the basin. * * * That the Denver beds were deposited in shallow waters is shown by the frequent cross bedding observable both in sandstone and conglomerate, and by the plant remains and standing tree stumps that abound at certain horizons. * * * The Archean material contains large boulders, and the sand grains are angular." (P. 33.)

The vertebrate paleontology of the Denver basin is treated by Professor Marsh in the later pages of the monograph. Nearly all of the typical vertebrate fossils of the Denver region here discussed "were essentially land animals, but not a few of them, especially of the Reptilia, lived near the water and there met their fate. The preservation of their remains was probably, without exception, due to their entombment beneath the waters of the great fresh-water lakes which existed in this region during Mesozoic and Cenozoic time." (P. 525.) The plants discussed by Knowlton are land plants, not lacustrine. The table of invertebrate fossils (p. 78, 79) gives none to the Arapahoe beds, and only six to the Denver beds, all of which imply 'fresh water,' and most of which suggest, according to my colleague, Dr. R. T. Jackson, a fluviatile rather than a lacustrine origin.

Now waiving for the time all reference to

the silty and probably lacustrine deposits on the plains farther east of the mountains than the region here described, may not all the facts of composition, structure and fossil contents, above set forth, be explained as well by fluviatile as by lacustrine conditions? Instead of assuming a series of warping and tilting movements by which lake basins were made and drained, is it not equally legitimate to assume changes of altitude, attitude, climate, drainage areas, etc., by which the rivers of the region altered their behavior from aggrading to degrading? The decision between these alternatives must, of course, not be attempted by an observer away from the ground; but in the meantime the lacustrine origin of the Arapahoe and Denver beds does not seem to be fully substantiated.

If they should finally be shown to be fluviatile, several corollaries that follow from the acceptance of a lacustrine origin would require modification. For example: "Movements of elevation and subsidence, rather of an epeirogenic or continental nature, are indicated by both Tertiary and Pleistocene deposits that have a lacustrine origin, since the present inclination of the plains region, which shows an average descent, in round numbers, of 10 feet to the mile from the foothill region to the valleys of the Missouri and Mississippi, would not admit of the holding of lake waters on its surface." (P. 40.) Fluviatile deposits are, on the other hand, characteristically inclined; and the present slope of the Plains may be not far different from their slope when the Arapahoe, Denver and later beds were formed, if they were spread out by aggrading rivers. I cannot help wondering whether even the peculiar cases of lapsing and overlapping strata, so well worked out by Eldridge about Golden and Boulder, may not find at least some part of their explanation by alterations of fluviatile accumulation and denudation, prompted by changes in grade, climate, drainage, area. etc., rather than depend altogether on movements of elevation and depression. The latter interpretation seems to postulate essential horizontality and rather regular continuity of strata at time of deposition; the latter permits or even requires significant declivity, inequality of thickness and irregularity of overlaps at time of deposition. Indeed, since the question of the fluviatile origin of some of the younger deposits on the Plains has been accepted by geologists familiar with that great field, the possibility of a fluviatile origin for some of the older formations springs to mind. The coarser and non-fossiliferous strata of the foothill belt in particular may, perhaps, be the fluviatile equivalents of finer and fossiliferous strata of lascustrine or marine origin farther eastward on the Plains.

W. M. Davis.

Cambridge, Mass., September, 1897.

THE GRANT SARCOPHAGUS.

On one of the most beautiful sites on the Island of Manhattan stands the mausolæum which the gratitude of a nation has erected to the memory of its illustrious hero.

The altar in this temple of the dead is the sarcophagus, beautiful and imposing in its severe simplicity. The stone out of which it is hewn is a dark red granite, quarried at Montello, Marquette county, Wisconsin.

Concerning the granite of this region Professor Allan D. Conover wrote:* "The rock shows almost no tendency to decompose. It has a medium grain, close texture, is of a bright pinkish color, and without sign of arrangement of the ingredients in lines. These are: Rather large flaked, pinkish, cleavable feldspar, predominating;

* Gannett's Report on the Building Stones of the United States and Statistics of the Quarry Industry for 1880.

somewhat granular, fine, pinkish, translucent quartz, abundant; and greenish-black mica sparsely scattered in blotches made up of very fine flakes. In places thin, light green epidote-colored seams occur.

"Though this granite may be somewhat difficult to obtain in dressable masses, it would probably make a very handsome and durable building and ornamental stone."

Cover and box were quarried from the same ledge of stone; in other words, the original was a monolith in the quarry. For ease of working, however, and in accordance with custom and usage, this monolith was cut up into pieces approximating to finished sizes before being sent from the quarry. About six months were needed to complete the work after it was begun.

It its entirety the sarcophagus weighs seventeen thousand pounds; the largest piece weighs nine thousand pounds. Its entire length is ten feet four inches; it is five feet six inches wide and four feet eight inches deep.

The pedestal on which it rests is made of dark gray granite from Quincy, Mass.

A fragment of the sarcophagus, analyzed by the writer, was found to have the following composition:

	Per cent.
Silica, SiO_2	75.40
Aluminum oxide, Al_2O_3	11.34
Iron oxide, Fe_2O_3	4.16
Calcium oxide, CaO	0.90
Potassium oxide, K_2O	6.44
Sodium oxide, Na_2O	1.76
	100.00.

Its specific gravity (17.5 °C.) is 2.635. The stone is a true granite, accepting as such granite having for its essential constituents quartz and potash feldspar. The feldspar is orthoclase, in which some of the potassium is replaced by sodium.

Mausolæum and sarcophagus were erected under the direction of C. W. Canfield, Esq., of the New England Monument Company, to whose courtesy the writer is indebted for the details given and for the fragment of the sarcophagus subjected to analysis.

FERDINAND G. WIECHMANN.

BOTANICAL NOTES.

BOTANICAL ACTIVITY IN JAPAN.

A RECENT bulletin of the Imperial University of Tokyo (College of Agriculture Bull., Vol. III., No. 3) indicates a degree of activity in the study of botanical problems which must challenge the respectful attention of botanists in Europe and America. It is not too much to say that the papers which appear in this bulletin are of a higher order of merit than are the papers in most of the similar bulletins from American universities, or colleges of agriculture. The titles alone are sufficient to indicate the high scientific value of the bulletin: 'On the origin of sake yeast (*Saccharomyces sake*),' 'Note on a grape wine fermented with sake yeast,' 'On the behavior of yeast at a high temperature,' 'On two new kinds of red yeast,' 'On Brom-albumin and its behavior to microbes,' 'On an important function of leaves,' 'On the behavior of active albumin as a reserve material during winter and spring,' 'On the physiological action of neutral sodium sulphite upon phænogams,' 'On the poisonous action of ammonium salts upon plants.' The most important paper is probably that by M. Suzuki on a function of leaves, in which the author summarizes the results of numerous experiments as follows: "The conclusion seems justified that reserve proteids in the leaves are decomposed into amido-compounds during the night, and the latter are transported from the leaves to the other parts of the plant. The migration of amido-compounds appears to proceed rapidly, as I have found no large quantity in the leaves

gathered in the morning. Thus an important function of the leaves is positively established. This function consists in facilitating the formation of proteids in all parts of the plants by the assimilation of nitrates, yielding thereby amido-compounds which are in all probability better sources for proteid formation than nitrates, in organs poorer in sugar and with a less energetic respiration process. A great advantage is thus gained for the stems, roots and fruits, in which the conditions for nitrate assimilation are less favorable than in the leaves. These amido-compounds produced are either asparagin, which, as I have shown in a former article, can be formed synthetically from ammonium salts as well as from nitrates, or they are the decomposition products of proteids formed in the assimilation of nitrates."

A BROADER STUDY OF LOCAL FLORAS.

IT is a hopeful sign of a broadening conception of the work of the local botanist that we see in a recent plant catalogue issued by Professor McClatchie and entitled the 'Seedless Plants of Southern California.' We have so long been familiar with plant catalogues which include nothing more than the flowering plants, often innocently regarded by their compilers as quite completely representing the flora, that it is refreshing to find one in which the flowerless plants are enumerated, while the flower-bearing species are omitted.

Not content with such a departure from time-honored custom, the author prefaces his work with a descriptive synopsis of the classes and orders and freely introduces handy artificial keys to the genera, thus departing still more from the old-style treatment. The synopsis of the plant groups shows that the the author has been more than a mere cataloguer of forms. He has been a student of the groups of which the species are representatives. Accordingly we find that the sequence and limitations of classes and orders are considerably different from those of the ordinary text-books. For this the author has been criticized by some botanists, but we cannot agree with these critics. It will be far better for botany when local students put more rather than less thought into their work, and, instead of deprecating their attempts to make improvements in the general system, we should rather welcome them as hopeful indications that the day of the old-time compiler of bare lists of species, following blindly the prevailing system, is drawing to a close.

In the smaller matters, also, this list is strictly modern, as in the consistent use of metric units in all measurements, the decapitalization of all specific names, the use of trinomials (for varieties), the omission of the comma after the specific name, and the double citation of authorities in the case of species which have been removed from the genera in which they were first described.

CHARLES E. BESSEY.

THE UNIVERSITY OF NEBRASKA.

NOTES ON INORGANIC CHEMISTRY.

THE *Jahrbuch für Mineralogie* contains further investigations, by C. Doelter, on the permeability of minerals for the X-rays. Phenacite (silicate of glucinum) is almost perfectly transparent, even more so than boric acid. Olivine and zoisite are, like calcite, almost opaque; vesuvianite slightly less so. Diopside and hiddenite, like topaz, are half transparent. Sphene is almost opaque, sapphire almost transparnt, the ruby hardly less so. A close relationship appears between the atomic weights and the permeability to the X-rays.

ACCORDING to L. Davy in the *Comptes Rendus*, all authors who have studied the ancient working of tin in the west of Eu-

rope admit that it was far anterior to the occupation of the country by the Romans, and think that the mines of Abbaretz-Nozay were abandoned by the Gauls about the date of the Roman invasion.

In a pamphlet entitled *Gold Growth* (Cincinnati, The Robert Clarke Co.), Mr. John Jacob Wagner asks: "Does nature transmute silver into gold?" "If it does, can we derive and utilize such hints, from nature's operation, as will enable us to attain artificial transmutation?" The former question he answers in the affirmative in the pamphlet before us; to the latter he promises a reply 'in due time.' The basis of the author's argument is that gold in nature is always found associated with silver, and the ratio of gold to silver is not uniform. If silver never occurs without some gold, it follows that the gold has grown from the silver, and the varying proportions found in different mines are due to the length of time the growth has been going on. Hence in the older rocks the proportion of gold to silver is greater then in the later rocks. Pure gold can be separated from silver alloy; but the 'fine silver' resulting invariably contains gold. The inference is that the silver is 'growing' into gold. This pamphlet belongs to a class of writings by no means rare, the efforts of laymen to clear up facts and theories which are far from clear to specialists who have devoted their lives to them. Granted that the premises of the writer are true, his deductions would have no weight to a chemist. He finds not merely silver and gold occurring together, but many other elements always associated with each other. If gold 'grows' from silver, why not potassium from sodium, or bromin from chlorin, etc.? The only difficulty with the theory is that at present there is absolutely no evidence of facts to support it, and the wisest chemists hesitate to philosophize on the problem of the genesis of the elements. It may be questioned if books, such as that before us, have any value; certainly they have not from a scientific standpoint.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE DEDICATION OF THE YERKES ASTRONOMICAL OBSERVATORY.

THE University of Chicago has made very complete arrangements for exercises in connection with the dedication of the Yerkes Astronomical Observatory, to continue throughout the present week. The arrangements are as follows:

OCTOBER 18, MONDAY.

2:30 p. m. Fourth Annual Meeting of the Board of Editors of the *Astrophysical Journal.*

4:30 p. m. Opening session of conferences. Informal talks on recent investigations, including:

Assistant Professor F. L. O. Wadsworth (Astrophysicist, Yerkes Observatory), on the application of Diffraction Phenomena to Astronomical and Astrophysical Measurements.

Dr. G. F. Hull (Professor of Physics, Colby University), on Electric Radiation.

7:30 p. m. Assistant Professor Wadsworth will demonstrate with the 40-inch Yerkes telescope the application of interference methods to astronomical measurements.

Professor Burnham will show selected double stars with the 40-inch telescope.

OCTOBER 19, TUESDAY.

9:00 a. m. Second session of conferences.

Dr. Henry Crew (Professor of Physics, Northwestern University), on the Source of the Characteristic Spectrum of the Metallic Arc.

Dr. Henri Deslandres (Astrophysicist, Paris Observatory), on a subject to be announced later.

Dr. W. J. Humphreys (University of Virginia), on the effect of Pressure on Wave-length.

Professor James E. Keeler (Director of the Allegheny Observatory), on the Spectra of Stars of Secchi's Third Type.

Professor H. C. Lord (Director of the Emerson McMillin Observatory, Ohio State University), on Researches in Stellar Spectography.

Professor Carl Runge (Director of the Spectroscopic Laboratory, Technische Hochschule, Hannover), on Oxygen in the Sun.

Professor Ormond Stone (Director of the Leander McCormick Observatory, University of Virginia), on the Great Nebula of Orion.

2:15 p. m. Address on the Yerkes Observatory by Professor George E. Hale, Director.

3:00 p. m. Professor Hale and Mr. Ellerman will show various solar phenomena with the 40-inch Yerkes telescope, including the chromosphere and prominences, the reversal of the H and K lines in prominences and faculæ, the duplication of the D_3 line, etc.

Experimental demonstrations will be given in the Observatory laboratories as follows:

Experiments with the rotating arc, Professor Crew.

Analysis of electric radiation by means of the interferometer, Professor Hull.

The effect of pressure on wave-length, Dr. Humphreys.

Measurements of wave-lengths in the infra-red spectrum, Assistant Professor Wadsworth.

Demonstrations in the Optical Shop, and in the Instrument Shop.

7:30 p. m. Professor Barnard will show with the 40-inch Yerkes telescope:

N. G. C. 224 (Andromeda Nebula).
N. G. C. 598.
N. G. C. 1976 (Orion Nebula).
N. G. C. 2245 (cometary nebula).
N. G. C. 2392 (planetary nebula).
N. G. C. 6543 (planetary nebula).
N. G. C. 6618 (Swan nebula).
N. G. C. 6720 (annular nebula).
N. G. C. 7009 ('Saturn' nebula).
N. G. C. 7078 (globular cluster).
R. Leporis (Hind's crimson star).
Selected variable stars.

The 12-inch refractor and 24-inch reflector will be used for miscellaneous observations.

OCTOBER 20, WEDNESDAY.

Professor George C. Comstock (Director of the Washburn Observatory, University of Wisconsin), on Determination of Stellar Parallax, and on Investigations of the Lunar Atmosphere.

Professor C. L. Doolittle(Director of the Flower Observatoy, University of Pennsylvania), on the Latitude Work of the Flower Observatory.

Father Hedrick (Astronomer, Georgetown College Observatory), on the Photochronograph.

Professor H. S. Pritchett (Director of the Observatory, Washington University,) on Personal Equation in Longitude Determination.

Dr. Charles L. Poor (Associate Professor of Astronomy, Johns Hopkins University), on a New Form of Mirror for Reflecting Telescopes.

Professor J. K. Rees (Director of the Columbia University Observatory), on the Variation of Latitude and the Reduction of the Rutherfurd Photographs.

Assistant Professor F. L. O. Wadsworth, on a Photographic Meridian Circle.

Professor E. E. Barnard (Astronomer, Yerkes Observatory), on Astronomical Photography.

Father Hagen (Director of the Georgetown College Observatory), on An Atlas of Variable Stars.

Professor G. W. Hough (Director of the Dearborn Observatory, Northwestern University), on Jovian Phenomena.

Professor G. W. Myers (Director of the Observatory, University of Illinois), on the System of β Lyræ.

Professor Simon Newcomb, on a subject to be announced later.

Professor E. C. Pickering (Director of the Harvard College Observatory), on the Work of the Harvard College Observatory.

7:30 p. m. Professor Hale will show the spectra of the following objects with the 40-inch Yerkes telescope:

N. G. C. 1976 (Orion Nebula).	α Lyræ.
N. G. C. 7027.	α Tauri.
Alcyone.	α Orionis.
DM. 30° 3639.	

OCTOBER 21, THURSDAY.

8:30 a. m. Departure from Chicago, of the special train.

9:30 a. m. Final session of conferences.

Dr. Kurt Laves (the University of Chicago), on the Teaching of Theoretical Astronomy in America, and on Jacobi's Investigations in Theoretical Astronomy.

11:30 a. m. Formal Presentation and Acceptance of the Yerkes Observatory.

1. Address: 'The Importance of Astrophysical Research and the Relation of Astrophysics to other Physical Sciences.' Professor James E. Keeler, Sc.D., Director of the Allegheny Observatory.
2. Presentation. Mr. Charles T. Yerkes.
3. Acceptance on behalf of the Trustees. The President of the Board of Trustees.
4. Acceptance on behalf of the University. The President of the University.
5. Prayer. Charles Kendall Adams, President of the University of Wisconsin.

1:00 p. m. Luncheon.

2:00 to 3:30 p. m. Inspection of the Yerkes Observatory.

October 22, Friday.

10:00 a. m. Inspection of the Ryerson Physical Laboratory and other buildings of the University of Chicago.

In the Ryerson Laboratory Head Professor Michelson and Associate Professor Stratton will demonstrate the effect of a magnetic field on radiation, and exhibit an interferential comparer and a new form of harmonic analyzer.

1:00 p. m. Luncheon given by the President of the University.

3:00 p. m. Address: 'Aspects of Modern Astronomy.' Professor Simon Newcomb, LL.D.

7:30 p. m. Banquet.

THE LABORATORIES OF THE BRITISH GOVERNMENT.

The Revenue Laboratories of the British government for chemical examination and analysis have just been housed in a new building erected adjacent to King's College Hospital. From the London *Times* we take the following facts regarding the building and its equipment: It occupies a site of about 7,900 square feet, and its various rooms, 38 in number and capable of accommodating about 100 workers, are distributed over three floors and a basement. The building externally is befittingly simple in character, and, with the exception of the entrance, which faces Clement's Inn, is altogether devoid of any attempt at ornamental treatment. On the ground floor are situated the office of the Principal Chemist, the Deputy Principal, a small reference library, the research laboratory, the crown contracts laboratories, and the laboratory for the examination of food and drugs sent by magistrates under the Adulteration Act of 1875. Samples of imported butter taken by customs officers at the port of entry at the instance of the Board of Agriculture are also examined in this laboratory, as are samples of fertilizers and feeding stuffs referred in accordance with the Act of 1893.

The first floor is wholly reserved for the examination of alcoholic products and manufactured tobacco. The alcohol laboratory, arranged for 32 workers, is a lofty, well-lighted room, with conveniently-disposed work-tables fitted with various contrivances for the rapid and accurate examination and analysis of brewing materials, worts, beers, wines, tinctures, medicated wines, compounds, etc. In the same laboratory is conducted the examination of the wood naphtha required for the methylation of alcohol. Round the room are placed the balances needed for the estimation of density, etc., and under each window is a table for the clerical work of the analysts, special arrangements being made for the keeping and preservation of the official registers. Immediately adjoining are the polariscope room and an artificially cooled chamber, capable of holding some thousands of samples pending examination. Close to the entrance of the main laboratory are the offices of the superintending analysts, each fitted with a working bench and with presses for the custody of microscopes and special apparatus. Next to these are the tobacco rooms. In one of these the incineration work, required for the determination of sand and inorganic matter, is conducted in muffle-furnaces fired by gas. The estimation of moisture in manufactured tobacco, instituted in 1887, are also conducted in this room, the samples being heated in a series of jacketed steam ovens, arranged to work continuously night and day. The main tobacco laboratory is fitted with appliances for the examination of manufactured and the so-called 'offal' tobacco for determination of drawback and for the detection of fraudulent or improper admixtures.

On the second floor are placed a number of special rooms, a museum of specimens of adulterated foods and other products, a small class-room for the instruction of supervisors, a typewriting office, and a room for the preparation of micro and other photographs.

In the basement are situated rooms for the standardization of the instruments employed in the revenue service, and laboratories for the chemical and bacteriological examination of waters sent by the Prison Department of the Home Office, the Board of Trade, Office of Works, and other public departments. There is also here provision for operations requiring a high temperature, as in furnaces, oil and air baths, etc.; a small mechanical laboratory, rooms for the storage of chemicals, apparatus and stationery, and of samples required to be

preserved either for purposes of reference or pending prosecutions.

AMERICAN MATHEMATICAL SOCIETY.

BEGINNING with the present academic year, the regular meeting of the American Mathematical Society will, as we have already noted, be held on the last Saturday of October, February and April, instead of monthly from October to May as heretofore. The annual meeting for the election of officers takes place in the last week in December, falling this year on Wednesday, December 29th. Each meeting will now extend through two sessions, beginning at 10:30 a. m. and 2.30 p. m. As a result of the arrangement, it is believed that the individual meetings will become of greater prominence and interest, and that the members of the Society will be afforded a better opportunity for mutual acquaintance and scientific discussion. The first meeting of the Society under the new program will be held on Saturday, October 30th, in Room 301 of the Physics Building of Columbia University, New York City. The following is a list of the papers thus far entered for presentation:

MORNING SESSION.

1. Dr. G. W. HILL: 'Intermediary orbits in the lunar theory.'
2. Mr. P. R. HEYL: 'Notes on the theory of light on the hypothesis of a fourth dimension.'
3. Dr. E. O. LOVETT: 'Note on the fundamental theorems of Lie's transformation groups.'
4. Professor CHARLOTTE ANGAS SCOTT:
5. Professor E. W. BROWN: 'Note on the steering of an eight-oared boat.'

AFTERNOON SESSION.

6. Professor R. S. WOODWARD: 'On the cubic equation defining the Laplacian envelope of the earth's atmosphere.'
7. ———— 'On the integration of a system of simultaneous linear differential equations.'
8. Professor MANSFIELD MERRIMAN: 'The probability of hit on a target when the probable error in aim is known; with a comparison of the probabilities of hit by the methods of independent and parallel fire from mortar batteries.'
9. Professor A. S. CHESSIN: 'Note on hyperelliptic integrals.'

DURING the past year a section of the Society has been organized with headquarters at Chicago. The meetings of the section, like the summer meeting of the Society, usually extend through two days, and are held in the Christmas holidays and in April.

THE October number of the *Bulletin* (Vol. 7, No. 1) has just been issued, and contains, beside the usual 'Notes' and 'List of New Publications,' the report by the Secretary of the Summer Meeting at Toronto, articles on 'Regular Triple System,' by Professor E. H. Moore; on 'Collimations in a Plain with Invariant Quadric or Cubic Curves,' by Professor H. S. White; on 'A generating Function for the Number of Permutations with an Assigned Number of Sequences,' by Professor Frank Morley; and a review of Koenig's 'La geometrie réglée et ses applications,' by Dr. Virgil Snyder.

GENERAL.

THE fifteenth annual Congress of the American Ornothologists' Union will meet at the American Museum of Natural History, New York, on the evening of November 8th, and will continue in session on the three following days.

THE directors of the Philadelphia museums propose holding in October of next year an exposition of the raw and manufactured products of the United States. It will be in conjunction with the next meeting of the advisory board of the museum, which will be attended by many foreign delegates.

MEMORIAL exercises in honor of the late General Francis A. Walker were held by the Massachusetts Institute of Technology, in Boston, on October 14th. There were more than 3,000 people present in Music Hall, including many delegates from educational and scientific institutions. Addresses were made by Governor Walcott and Senator Hoar.

PROFESSOR J. M. SCHAEBERLE has been appointed acting director of Lick Observatory in the place of director Edward S. Holden, whose resignation is noted elsewhere in this issue. It is said that either Professor Schaeberle or Professor Davidson will probably succeed Professor Holden in the directorship.

LORD KELVIN sailed for England on Saturday, after a week filled with engagements, including

a reception by the American Philosophical Society, a reception at Princeton and a luncheon at Columbia University.

DR. JOHN GUITERAS, of the University of Pennsylvania and the U. S. Marine Hospital Service, has returned to Philadelphia, after having made a thorough study of the yellow fever in the South, and will present an exhaustive report of his inspection to Surgeon-General Wyman.

MR. W. G. MACMILLAN, lately lecturer in Mason College, Birminghom, has been appointed Secretary of the British Institution of Electrical Engineers.

PROFESSOR GUNDELFINGER, of the Botanical Institute of Darmstadt, has been awarded the gold medal for merit of the Munich Academy of Sciences.

WE note with much regret the death of Charles E. Colby, since 1889 professor of organic chemistry in Columbia University. He was born in Lawrence, Mass., in 1855, and graduated from the School of Mines of Columbia College in 1877. Professor Colby's work was hampered by deafness and ill-health, but he was a chemist of unusual ability, and his death is a serious loss to Columbia University.

DR R. P. H. HAIDENHAIN, since 1859 professor of physiology at Breslau, died on October 13th, aged sixty-three years. He is the author of important contributions to experimental physiology, his work on secretion being perhaps the most valuable.

WE also regret to record the deaths of Dr. Edmund Drechsel, professor of medical chemistry in the University of Berne, aged fifty-six years, and of Dr. Stoll, formerly director of the Pomological Institute at Proskau, aged eighty-four years.

A DISPATCH to the daily papers stated that during an ascent of Mount Ararat, Armenia, by members of the recent Geological Congress, Dr. Stoeber, a professor of medicine, was frozen to death.

KITES sent up on October 15th, from the Blue Hill Observatory, surpassed the record of September 19th, recorded by the director, Dr. Rotch, in a recent issue of the JOURNAL, by more than 1,500 feet. They carried the meteorological instruments to a height of 10,900 feet above the hill top, or 11,500 feet above sea level. The kites were sent up at 3:50 o'clock in the afternoon and reached the highest point by six o'clock. At that altitude the temperature was 43°, while it was 73° at the ground.

DURING the course of a lecture at Montevideo, on October 15th, Dr. Sanarelli stated that the serum he has obtained from the animals with which he has been experimenting is effective against yellow fever, and that it will very probably cure yellow fever in human beings.

IT is reported that the Cavendish Sporting Expedition through Africa arrived safely at Kikuiu on August 5th, and started for Zanzibar on August 15th. The expedition has crossed from the Gulf of Aden by somewhat the same route as that of Dr. Dondaldson Smith, and is said to have made valuable geographical explorations.

IT is doubtless known to all our readers, from the daily press, that the British Foreign Office has agreed to a scientific conference on the seal fisheries by delegates from the United States, Great Britain and Canada. Professor d'Arcy Thompson will, it is reported, leave at once for the United States.

A BERLIN despatch to the New York *Sun* states that the International Leprosy Conference, which has been in session for a week, expects to conclude its deliberations on Saturday. Comparatively little has been added to the knowledge of the disease, except what was contained in a statement by Dr. Babes, of Bucharest, that leprosy bacilli were found in great abundance in mucus, which, accordingly, was a dangerous channel of infection. Another debate resulted in a concurrence of opinion that leprosy was not specifically a skin but a general disease. There was much discussion as to the treatment of the disease, especially of experiments with serum. All the experiments had been without result, except in one case, where the outcome is in doubt. The conference appointed a commission to prepare plans for the formation of an international leprosy society. Professor Virchow is the president of the commission, and Dr. Dyer, of New Orleans, is a member.

THE Audubon Monument Association of New Orleans is collecting money for a monument of Audubon to be placed in the park named after him in New Orleans. For this purpose the Association offers to sell a memorial volume giving an account of Audubon's life, prepared by Mrs. M. F. Bradford.

A CHEMICAL society has been formed at Brown University. It held its first meeting on October 5th, when an address was given by Professor John Howard Appleton on 'Recent Discoveries in Chemistry.'

FOUNDERS' Day at Lafayette College was celebrated on October 20th, the exercises being a tribute to Professor T. C. Porter, who this year retires from active service after sixty years devoted to the natural sciences, which he has taught at Lafayette College for thirty years. According to the program addresses were to have been made by Professor Nathaniel L. Britton, of Columbia University, the director of the New York Botanic Garden, on 'The Progress of Systematic Botany in North America,' by Professor William B. Scott, professor of geology in Princeton University, on 'Thirty Years of Geological Progress in North America,' and by Dr. John M. Crawford, of the class of 1871, lately Consul-General to St. Petersburg, on 'Dr. Porter as Pioneer in Finnish Literature.'

THE Commissioners of Works and Public Buildings, London, offer to distribute this autumn, among the working classes and poor inhabitants of London, the surplus bedding-out plants in Hyde and Regent's Parks and in the pleasure gardens of Hampton Court.

The Auk states that a unique and exceedingly appropriate memorial to the late Henry Davis Minot consists of a park of some fifty acres in extent, recently transferred by his four brothers, William, Charles S., Robert and Lawrence Minot, in accordance with the wishes of their father, the late William Minot, to the trustees of public reservations in Massachusetts, to be maintained as a wild park, 'for the use of the public forever.' This park, to be known as Mount Anne Park, consists of a tract of about fifty acres of beautiful woodland near the village of West Gloucester, Mass. It includes Mount Anne, or Thompson's Mountain, the highest point on the North Shore, some 225 feet above the sea—a pine-clad, granite summit in the midst of a forest wilderness. The park is otherwise charmingly diversified, being a spot of exceptional natural beauty.

THE Lowell textile school has opened its second year with an attendance of 230 students, twice as many as last year. Classes this year will be formed by Professor W. W. Crosby, of the Massachusetts Institute of Technology, Professor Fenwick, of Umpleby, and others.

MR. C. W. ANDREWS, of the British Museum, has been sent by the trustees to Christmas Island, the expenses of the expedition being defrayed by Dr. John Murray, for the purpose of making collections of the fauna for the British Museum. Christmas Island, about 200 miles south of Java, is only inhabited by some twenty-two persons, but it is soon to be used by a phosphate company, hence the importance of making collections of the fauna and flora, which are unusually interesting, a large proportion of all the species being endemic.

MESSRS. MACMILLAN & Co., Limited, have removed from their familiar building near Covent Garden to St. Martin's street, London, W. C., where they have erected a magnificent building of Portland stone, with a frontage of 106 feet in Whitcomb street, 99 feet in St. Martin's street and 24 feet in Blue Cross street. The editorial and publishing offices of *Nature* are removed to the new site, as also the British agency of SCIENCE.

THE valuable collection of vertebrata made by Mr. A. C. Savin from the forest bed, Norfolk, has been purchased by the British Museum (Natural History).

THE Sunday *Inter-Ocean*, Chicago, has published in successive issues a series of articles on the collection of fossils of Mr. W. T. E. Gurley, from 1893 to 1897 State Geologist of Illinois. In addition to tens of thousands of duplicates and unclassified specimens, the collection is said to contain over 14,000 species, all labeled and in good condition, divided about as follows: Types of batrachians and reptiles, 65; fishes (entire), 145; fish teeth, spines and bones, 765; insects and arachnids, 66; myriapods and crustaceans (exclusive of trilobites),

230; trilobites, 425; annelids, 40; rhizopods and polyzoans, 10; sponges, 60; bryozoans, 760; corals and allied forms, 1,525; lamellibranchs, 1,625; gasteropods, 1,800; cephalopods, 850; pteropods, 60; brachiopods, 3,175; cystids, 35; echinoids, 175; blastoids, 150; star fishes, 50; crinoids, 1,250 (fully 700 with heads and arms complete); hydrozoa, 90; diatoms, 25; plants, 400. The collection, as we have stated, is for sale and it is hoped that it may be secured for some institution in Illinois.

AN item in the daily papers to the effect that M. Becquerel has recently been admitted with honors to the École polytechnique, Paris, is of sufficient interest to be quoted here, in view of the fact that he is the son, grandson and great-grandson of eminent physicists. M. Henri Becquerel, his father, is the distinguished professor of physics in the École polytechnique; A. E. Becquerel, the grandfather, formerly professor of physics in the École des Arts et Metiers, is well known for his important contributions to physics, chemistry and meteorology; the great-grandfather, A. C. Becquerel, director of the Paris Museum of Natural History, was a physicist of great eminence, whose discoveries in electro-chemistry are known everywhere; an uncle, L. A. Becquerel, was also a man of science of distinction.

DR. W. F. MORSELL sends us the following further decisions of the United States Board on Geographic Names: In Kansas it should be *Junction*, not Junction City, as generally understood; so, also, in the same State, Empire City and Osage City are similarly abbreviated by the Board. A dozen or more decisions affect names in New York State, but they are unimportant. The creek, mountain and pond in Essex county is *Vanderwhacker*, not Van der Whacken, etc., and the river in the Adirondack region is *Sacundaga*, not Sacandaga, Sacondago, etc., as variously written. The channel north of Staten Island is Kill *van* Kull, not Kill *von* Kull, being of Dutch origin, not German. In Gilmer county, Georgia, there is a postoffice which the Board writes *Santaluca*. This is not from the Spanish, as one would suppose, but from the Cherokee Indian language. Among foreign names, on which there are a few decisions, the Board decides on *Austria-Hungary*, and also favors *Burma* (not Birmah nor Burmah). The German city should be *Mainz*. The German government has protested to our Consuls for spelling the word in the French way—Mayence.

THE Macmillan Company have just published the course of lectures by 'The Founders of Geology' given last winter by Sir Archibald Geikie to inaugurate the lectureship in the Johns Hopkins University founded by Mrs. Williams in memory of the late Professor Williams. In the preface to the volume Sir Archibald Geikie speaks of geological work and geological opportunity in America as follows: "Renewing old friendships with some of the veterans of the science, and forming fresh ties of sympathy with many younger workers who have come to the front in more recent years, I could not but be impressed by the extraordinary vitality which geology has now attained in the United States. Every department of the science has its enthusiastic votaries. Surveys, professorships, museums, societies, journals in almost every State, are the outward embodiment of the geological zeal that appears to animate the whole community. This remarkably rapid development of the science has not arisen from any influence derived from without, but springs, as it seems to me, from the marvellous geological riches of the American continent itself. In minerals and rocks, in stratigraphical fulness, in paleontological profusion, in physiographical illustrations, the United States have not only no need to borrow materials from Europe, but in many important respects can produce examples and materials such as cannot be equaled on this side of the Atlantic. Had the study of the earth begun in the New World instead of the Old, Geology would have unquestionably have made a more rapid advance than it has done. The future progress of the science may be expected to be largely directed and quickened by discoveries made in America, and by deductions from the clear evidence presented on that continent."

THE *American Geologist* publishes two extraordinary letters from the person who has been appointed State Geologist of Missouri. One of these letters concludes as follows:

"I will now remind you that 'every dog has his day. This is my day and the time is not far distant when your client will wish he had carried his tracks along with him. That you and he have run up against the wrong man is only a question of time. You can make the most of your opportunity and I will pursue the even tenor of my way."

Such occurrences are discouraging, even though it is certain that their duration will be but brief. We are of the opinion that it is the duty of the Geological Society of America, even though it should cost each member one-tenth of his time and of his income for one year, to see that the facts of the case are brought before the Legislature and the people of Missouri.

THE outgoing Vice-Chancellor of Cambridge University stated in a valedictory address to the members of the Senate that the gifts to the museums and laboratories during the past year include a cast of the famous specimen of *Iguanodon bernissartensis* presented by his Majesty the King of the Belgians, a refrigerating machine for experimental purposes presented by Mr. T. B. Lightfoot, a valuable collection of dried plants presented by Mrs. C. Packe, a very important library of geological books presented by Professor Wiltshire, M.A., of Trinity College, who has on previous occasions shown himself to be a most generous benefactor to the University, and two collections of great historical interest presented by the family of the late Charles Darwin.

ACCORDING to the *Statist*, the yield of gold for 1896 was about £45,000,000, against an average of £21,738,000 for the period of 1881–90. For 1896 the production by fields was as follows: United States, £10,800,000; Australasia, £8,988,000; Transvaal, £8,604,000; India, £5,911,000; Russia and other countries, £10,-697,000—or a total of £45,000,000. The grand aggregate of the gold production since 1850 inclusive is, in round figures, £1,163,000,000, or, approximately, 300,000,000 ounces of gold.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Academic Freshman class at Yale University is said by the New York *Evening Post* to number 58 less than last year, while there is an increase of 15 students in the Scientific School. There is, this year, an increase of about 300 students at the University of Michigan, chiefly in the law department, and of over 100 at Columbia University. A decrease of about 50 students in the undergraduate department of Brown University is reported.

THE New York *Tribune* states that the University of Missouri receives $23,023 from the estate of the late John C. Conley, under the operation of a law recently passed by the Legislature which provides that if a man dies leaving no father, mother or direct lineal descendant a certain per cent. of his estate, excluding any amount left for charitable or religious purposes, must go to the State University.

DR. R. C. CHRISTIE, formerly professor at Owens College, Manchester, has given the College the whole of his share in the residuary estate of the late Sir Joseph Whitworth, estimated at £50,000. The College has also received gifts of £20,000 for the erection of a physical laboratory and £6,000 for its maintenance and of £1,500 towards the erection of a museum.

THOSE who last winter objected to the action of Cornell University in deciding to follow the example of the great English and other American universities and award the degrees A.B. and A.M. for scientific as well as for classical studies probably do not read this JOURNAL. Otherwise we should like to call their attention to the fact that Cornell in its short history has conferred forty-seven kinds of degrees, and ask whether it is an advantage to increase or decrease the numbers of kinds of degrees awarded for liberal studies.

THE Board of Overseers of Harvard University have concurred with the president and fellows in their votes changing the title of Hugo Münsterberg from professor of experimental psychology to professor of psychology, and of William James from professor of psychology to professor of philosophy.

DR. WILLIAM S. CARTER, of the University of Pennsylvania, has been elected professor of physiology in the University of Texas.

DR. CHARLES W. HARGITT, professor of biology in the College of Liberal Arts of Syra-

cuse University, will have charge of the work in embryology in the College of Medicine.

Dr. Edwin F. Northrup has resigned from the professorship of physics in the University of Texas. The students' paper of the University remarks: "During the brief thirteen years that the University of Texas has been in operation there have been no less than five professors in this school. Their tenure of office has been short, and, in the main, their departures abrupt."

DISCUSSION AND CORRESPONDENCE.

RESIGNATION OF THE DIRECTOR OF LICK OBSERVATORY.

After a continuous connection with the Lick Observatory for 23 years and a service at Mount Hamilton since 1888, I have terminated my official relations with the Observatory, to take effect on December 31, 1897. My address after October 1st will be as below:

Edward S. Holden.

Smithsonian Institution, Washington., D. C.

THE BOSTON PLANS FOR A NEW YORK BOTANICAL GARDEN.

To the Editor of Science: I wish to call your attention to an inexcusable piece of bad taste in the last number of *Garden and Forest.* That excellent journal was from its foundation edited by the late William A. Stiles, to whom the public park system of New York is so greatly indebted. It is, however, conducted, whatever that may mean, by Professor C. S. Sargent, director of the Arnold Arboretum. The last number of *Garden and Forest*, in an editorial notice of Mr. Stiles, gives as his crowning work the following:

"It was his forethought and technical knowledge which have modified and delayed the schemes of the men who in their zeal for a botanic garden are willing to deface, unnecessarily, Bronx Park, and could his life have been prolonged this most valuable and beautiful of all the rural possessions of the city might, perhaps, have been spared for the best enjoyment of the public."

It is well known that Professor Sargent's interference with the well matured and carefully prepared plans for the New York Botanical Garden, as enlarged upon in the daily press, has lessened the public appreciation of an institution so important for the scientific and general welfare of the City. It is commonly reported here that Professor Sargent does not wish New York City to possess a botanic garden superior to the one directed by him. This report is doubtless incorrect, but it will certainly not be silenced by using an obituary notice of a friend in the manner indicated.

You will, I hope, excuse me from giving my name for publication, and will permit me to state that I am in no way connected with the New York Botanical Garden.

N. Y.

New York City,
October 16, 1897.

SOURCE OF THE FAMOUS THETFORD LIMBURGITE.

Nearly half a century ago Dr. Oliver Payson Hubbard, while a member of the faculty of Dartmouth College, discovered large boulders of olivine basalt in Thetford, Vt., and discussed their probable derivation from basaltic areas in Canada.

Some of these boulders have found their way as museum curiosities to Chicago, Washington, New York and New Haven. They are particularly noted for their large rounded masses of olivine and crystalline, grayish green, glassy pyroxene.

In 1894 Dr. E. O Hovey presented to the scientific world, through the columns of the 'Transactions of the New York Academy of Sciences,' valuable information concerning the petrography of these basaltic boulders and referred them to the limburgite division of the family.

Professor J. F. Kemp has commented upon the striking resemblance of olivine diabase to these boulders, and discussed the improbability of a meteoric origin.

It has constantly been conjectured that their source was to the northward, since Vermont is in a region of extensive glaciation from that direction, yet geological research had failed to reveal their origin until last August.

During the summer of 1896, while engaged in field work in stratigraphical geology, I encountered many dikes of diabase rich in olivine, and others of the same microscopical appearance

as the typical camptonite in the Pemigewassett Valley, N. H.

By diligent investigation it was my good fortune last August to discover in the locality of these ramifying dikes and the famous Corinth copper mines an extraordinary dike of limburgite, from 6 to 10 feet in width, and penetrating the calciferous mica schist toward the west for more than half a mile.

This limburgite bears individual crystals of olivine two to three inches in length and one to two inches in breadth. A single specimen has been placed in the museum of Dartmouth College containing a crystal of olivine two and one-half inches by one and three-fourths.

Some of the smaller crystals by the oxidation of the iron have become converted into limonite or hematite; others have gone over into serpentine, while a bit of calcite derived from the contiguous orthorhombic pyroxene or the basic plagioclase feldspar is occasionally seen in the cavities once filled by the original olivine crystals.

As the locality is to the northward in the exact direction of the moving ice, and at a distance of only about twenty miles from the famous Thetford boulders, it seems evident that Corinth, Vt., was their original habitat.

C. H. RICHARDSON.

DARTMOUTH COLLEGE.

MORE DICTIONARY ZOOLOGY.

SOME time ago I called attention in your columns to the inaccurate zoological information given by a recently published dictionary. I have just had occasion to examine the *Encyclopædic Dictionary* (Philadelphia, 1896) and should like to ask how the editors explain the following eccentricities:

(1.) *Snail.* "*H. aspera* is also eaten." *Helix aspersa* is the snail intended; *H. aspera* is a totally different snail, found in the West Indies.

(2.) *Slug.* "*A. agrestis*, the Red Slug." There is no *Arion agrestis.* The article, with its errors, appears to have been taken (without acknowledgments) from an old edition of *Chambers' Encyclopædia.* If the editors had examined the recent edition of that standard work, published several years before 1896, they would have found a different account.

(3.) *Coccus.* The species assigned to *Coccus* belong to seven perfectly distinct genera; and no author in the last twenty-five years who has given any study to these insects has used the last century classification of the *Encyclopædic Dictionary.*

The editors of dictionaries will have to realize that if their zoological definitions and articles are to be accurate and up-to-date they must employ specialists to write or revise them. Until they do so, zoologists should make it their business to call attention to the misrepresentation of their science in works which the public is asked to receive as models of accuracy.

T. D. A. COCKERELL.

SEPTEMBER 25, 1897.

LANTERN TRANSPARENCIES.

TO THE EDITOR OF SCIENCE: Those who have occasion to have copies of engravings or pictures of any kind made for use with the lantern may be glad to know that such may be printed from the plates used in ordinary printing if sheets of thin transparent celluloid be taken. Gelatin also may be used. The latter is liable to roll up more or less and needs to be protected by inclosing between glass plates of the ordinary size for lantern slides. Celluloid will not trouble so much in that way, yet it is best to mount such pictures in the same way. Photographic half-tones show very well indeed, the fine meshing not being enough magnified nor dense enough to be noticed upon the screen at the distance of a few feet. Such copies need cost but a few cents apiece if the electro can be got to print from, and if celluloid be used without the glass cover perhaps one cent would be the full cost. I enclose a couple of samples that you may judge of the quality of such pictures.

A. E. DOLBEAR.

DANGERS OF FORMALIN.

TO THE EDITOR OF SCIENCE: Now that the use of formalin for preserving objects for dissection is becoming so common, I think a word of warning as to the danger involved in the use of even attenuated solutions should be given. It is doubtless a matter for the medical faculty to

explain and limit, but as no one has spoken from their ranks a word from a layman may be of service.

The handling of objects which have been preserved in a 4 % solution kills the outer cuticle and appears to have a paralyzing effect on the sub-cuticular nerve terminations. Repeated use demoralizes the skin very badly. The vapor or minute drops arising in dissection from the objects manipulated is liable to cause serious affections of the eye. We have just heard from a recent colaborator of the museum who has narrowly escaped the loss of one eye, and is probably condemned for life to the use of glasses as a result of dissections of slugs preserved in formalin. Irritation of the mucous membrane of the air passages has probably been observed by every one who has used this preservative.

WM. H. DALL.

U. S. NATIONAL MUSEUM,
WASHINGTON, D. C., October 12, 1897.

SCIENTIFIC LITERATURE.

Hallucinations and Illusions. A Study of the Fallacies of Perception. By EDMUND PARISH. London, Walter Scott; New York, Charles Scribner's Sons, 1897. Pp. 390. Contemporary Science Series, Vol. XXXI.

The present volume is a rewriting, by the author, of his German monograph, published about three years ago; and this in turn grew out of his examination, for the Munich Psychological Association, of the cases collected in Germany for the 'International census of Waking Hallucinations in the Sane'—a project initiated and vigorously promoted by the English Society for Psychical Research. While there is an extensive literature on some one or another of the many ramifications of the general subject of illusions—particularly contributions of cases illustrative of certain special kinds or causes of illusion—there is a conspicuous lack of more comprehensive and systematic treatises covering the general field, both descriptively and with the purpose of presenting these various forms of fallacious perception from some unifying theory or principle.

It can hardly be said that the author has succeeded in filling this gap, although the road which he set out to survey has been covered with accuracy and originality. Comparison is at once suggested with the older volume of Sully on 'Illusions,' which, though far less scientifically thorough and necessarily lacking in the explanations and conceptions that have grown out of recent research, is none the less more comprehensive in scope and more philosophical as well as attractive in treatment. The general reader will still find more enlightenment as to the nature of illusions in the work of Sully than in that of Parish, although he can find no abler treatment of certain phases of this study than the latter work offers. To begin with, Dr. Parish's definition of his topic rules out the consideration of that interesting group of normal deceptions of the senses—commonly known as optical illusions and the like—which are so significant for the study of sense-interpretation and perception. Indeed, instead of conceiving an illusion as any form of psychological process which happens to be erroneous he aims to establish a type of perception, at times normal and at times abnormal, as the basis of all hallucinations and illusions. This underlying principle is found to be that of dissociation, "a state in which, indeed, generally speaking, the consciousness is normal, but where the association-paths of a more or less complicated system of elements are wholly or partially blocked." Hallucinations and illusions "are just as much sensory perceptions as the so-called 'objective' perceptions." The dream state is an extreme state of dissociation, and as such hallucinations and illusions become the stuff that dreams are made of; in insanity and nervous fatigue; in moments of emotional excitement as well as of rapt attention; under the influence of drugs and particularly in hypnotic states, the conditions are favorable for that distortion and inhibition of the normal association-paths which Dr. Parish holds to be the starting point of fallacious perception.

This conception has much in its favor; it makes it natural to find a considerable number of hallucinations among the sane and in the waking state; it certainly binds together the various forms of semi-abnormal and morbid conditions under which illusions most commonly occur; it is equally adaptable to the explana-

tion of the experimental phases of the topic, such as hypnotism, automatic writing, crystal vision; and it further gains strength by the inherent weakness of former theories, both 'centrifugal' and 'centripetal,' which attempted to present the illusion as a reversal of the physiological process of true sensation or of some of the cortical and subcortical functions. In spite of these advantages, it cannot be claimed that this or any other theory at present serves any other purposes than that of a temporary framework for a building that is yet to be planned. The physiologist and the pathologist, as well as the alienist and psychologist, must all expend very much more planning and labor upon the foundations before a really suitable superstructure can be possible. More literally, the present status of the subject seems hardly likely to yield a true explanation of the illusory process, a satisfactory account of what really goes on in nerve and brain-cell as well as in the field of mental processes when we see with the mind's eye.

This criticism is offered in no disparagement of Dr. Parish's essay. His attempt to bring order out of chaos is most commendable, and for what is, perhaps, the most striking example of the fruitful nature of his conception the reader may be referred to is the ingenious analysis of 'audible thinking' as the analogy of 'automatic writing' which is given in Chapter VIII.

A considerable portion of the volume is devoted to the presentation of the statistics of hallucinations of the sane and their critical discussion, one phase of this discussion being devoted to those hallucinations which are supposed to be 'veridical' or to serve as proofs of 'telepathic' agencies. This portion of the work is most commendable; the sincerity and painstaking devotion of the compilers of the census and other evidence for telepathy are fully appreciated and acknowledged. But the verdict is 'not proven,' with a strong indication in favor of the negative. The extreme complexity and variety of the sources of error, the inherent defects of the logical cogency of the evidence, and the likelihood of the applicability of other and more normal forms of explanation, are all admirably set forth and together form a line of argument which the numerically strong but logically weak accumulations of cases are not likely to overcome. This careful sifting of obscure sources of error, this technical and thorough analysis of the real nature of these elusive hallucinatory conditions, makes rather difficult reading, but it is the only profitable mode of dealing with the subject.

This lack of popular attractiveness in Dr. Parish's work is probably a desirable feature, at least in some respects. The interest in this and kindred topics has been entirely too much centered upon the explanation of individual experiences and the proving of this or that hypothesis. The prevalent popular attitude is that of the man who has had an experience and wants it 'explained,' even to the most trifling detail, and who, in default of such explanation, feels warranted in disparaging the science that so dismally fails when practically tested, and in accepting any hypothesis, however unnatural or unscientific, which seems to cover his case. It is well to impress this individual with the inherent difficulty of such study, with the technical acquisitions needed to qualify one to form any opinion on the matter, and with the true statistical and impersonal method of dealing with 'cases.' The principle that in the progress of science the interest in the abnormal precedes and only slowly gives way to an interest in the normal has recently been well emphasized and illustrated;* it is as true in psychology as in other sciences. The superficial interest in much that is 'psychic' doubtless belongs to this earlier stage of culture and will probably give way to a better comprehension and appreciation of man's normal psychology. A lesser form of utility of the present volume is in disparaging an undesirable and uncritical interest in the abnormal.

JOSEPH JASTROW.

Manual of Bacteriology. By ROBERT MUIR, M.A., M.D., F.R.C.P., Ed., Lecturer on Pathological Bacteriology, and Senior Assistant to the Professor of Pathology, University of Edinburgh; Pathologist, Edinburgh Royal Infirmary; and JAMES RITCHIE, M.A., M.D., B.Sc., Lecturer in Pathology, University of

* By W J McGee, SCIENCE, Vol. VI., p. 413.

Oxford. With one hundred and eight illustrations. Edinburgh and London, Young J. Pentland; New York, The Macmillan Company. 1897. Price, $3.25.

Bacteriology as a distinct domain in biology has developed with amazing rapidity within the past few years, owing partly to the stimulus which a new technique has afforded, partly to the keener appreciation of the importance in biology of a knowledge of the simpler life process down near the border line; but more than all, perhaps, to the fact that among the bacteria are a few forms which cause a large part of the acute diseases of men and animals. For the latter reason bacteriology has been a foster child of medicine and, in the minds of many, is only one of the congeries of disciplines which we call medical science. But as our knowledge grows, we realize that the relationships of bacteriology to medicine embrace but a small part of bacteriological lore, which reaches far away from disease and deals with most significant phases of organic life throughout the earth.

In reality, the book before us is not a manual of bacteriology, but a manual dealing with those phases of bacteriology which concern disease, or medical bacteriology.

About one-fourth of the text relates to the general subject of the morphology, biology and technical methods of study of the bacteria; a few pages are devoted to non-pathogenic microorganisms, while the remainder is given to a general consideration of the relationship of bacteria to disease, and to an epitomized description of the more important infectious diseases, especially of man. A discussion of the significant subject of immunity follows and, finally, in a series of appendices, certain of the important infectious diseases are reviewed whose etiological factors are not bacterial or are as yet unknown.

There are many manuals of medical bacteriology in many languages and of all grades of excellence, and this phase of bacteriology is growing so rapidly that new books and new editions are necessary.

This book of Muir and Ritchie is a most valuable addition to the list and might wisely supersede many of the current elementary works. It is a well-digested, well-arranged and wisely and clearly expressed epitome of the medical phases of bacteriology and of the bacteriological phases of disease. The historical glimpses of recent studies upon some of the infectious diseases aid greatly in the comprehension of the present point of view regarding them and afford clues which, in connection with the judiciously limited bibliography at the end, may lure and guide the student into a deeper acquaintance with his theme. The illustrations, over one hundred in number, are largely from photo-micrographs and the half-tone reproductions are for the most part as satisfactory as the technical limitations will permit.

The book is altogether excellent, and is really a model epitome of a difficult and complex theme, a safe and stimulating guide to the student and a boon to the busy practitioner who must read as he runs, if he reads at all.

T. M. P.

NEW BOOKS.

The Founders of Geology. SIR ARCHIBALD GEIKIE. London and New York, The Macmillan Co. 1897. Pp. x+297. $2.00.

Les ballons-sondes de Mm. Hermite et Besançon et les ascensions internationales. Paris, Gauthier-Villars et fils. 1898.

The Story of Germ Life. H. W. CONN. New York, D. Appleton & Co. Pp. 199.

Health of Body and Mind. T. W. TOPHAM. 1897. Pp. 296.

Elements of Plane and Spherical Trigonometry. EDWIN S. CRAWLEY, University of Pennsylvania. 1897. Second edition. Pp. 178.

Physical Experiments. ALFRED P. GAGE. Boston and London, Ginn & Co. 1897. Pp. ix+97.

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A Correction: We have been requested to call attention to the fact that the sentence on p. 534, at the bottom of the first column of SCIENCE for October 8th last, beginning 'The Boston Trustees,' owing to an oversight was not omitted, as it should have been.